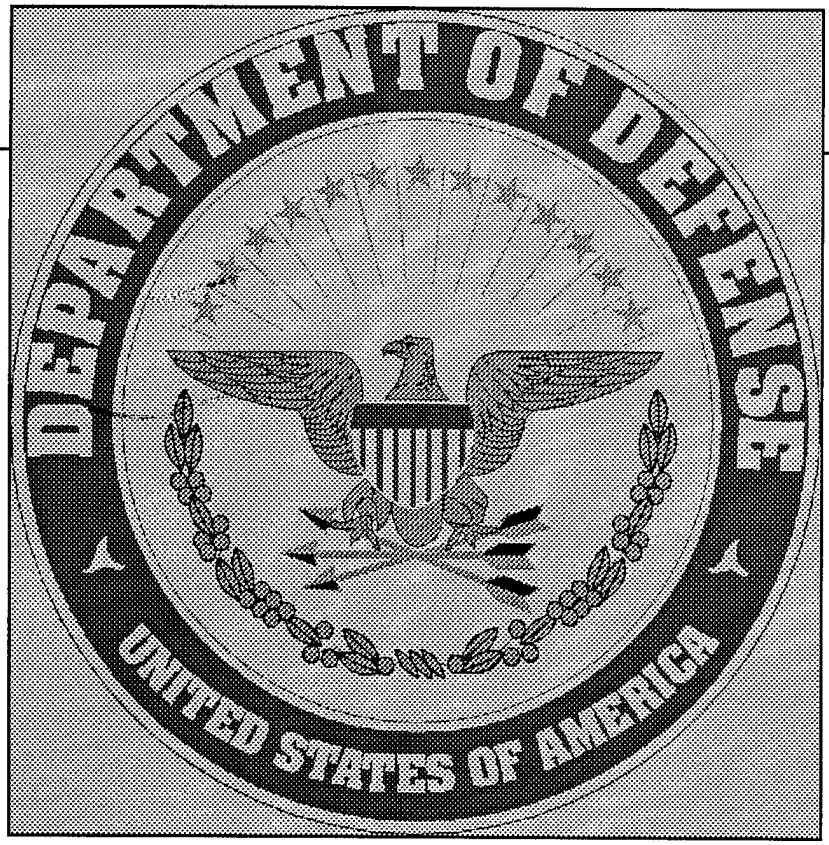

CAIS STANDARD MANUAL

SYSTEM NO. 30
WATER
TREATMENT PLANTS

CAS PROJECT
CAIS MANUAL

Issued April 28, 1995

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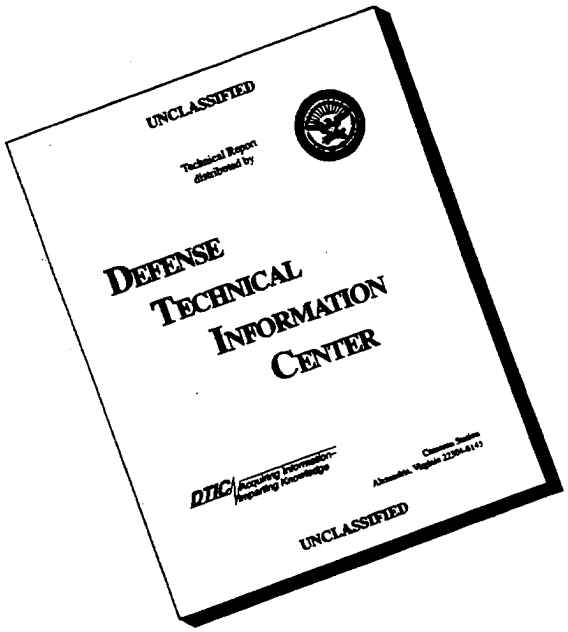

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FROM: AL/EQ (STINFO)
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1. As per telephone conversation with Andrew Poulis, EQ/TIC, the attached CAIS CTDS manuals are forwarded for accession, cataloging, and microconversions. Please forward the accession numbers to:

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3. If you have questions about these documents, please contact Andrew Poulis at DSN 523-6285.

LARRY L. TESTERMAN
Scientific and Technical
Information Program Manager

Atchs: Manuals

30 WATER TREATMENT PLANTS

TABLE OF CONTENTS

30 WATER TREATMENT PLANTS

PAGE

SUBSYSTEM 30.02 RAPID MIX SYSTEMS

SUBSYSTEM 30.03 FLOCCULATORS SYSTEMS

SUBSYSTEM 30.04 SETTLING TANKS

30 WATER TREATMENT PLANTS

PAGE

SUBSYSTEM 30.05 RAPID SAND FILTER SYSTEMS

SUBSYSTEM 30.06 CLEAR WELL SYSTEMS

APPENDICES

30 WATER TREATMENT PLANTS

ABSTRACT

GENERAL ORGANIZATION

At this installation the list of facilities to be surveyed will be addressed on the basis of 32 unique systems that form the CAIS Engineering Deficiency Standards and Inspection Methods document. Each system deals with a specific technical aspect of the facility to be surveyed. Within each system a further breakdown is made to subsystems, each having a specific list of components. Specific observations of the listed defects are provided so as to allow the entry of observed quantification data. A DOD CAIS manual is provided for each of the 32 systems with an internal organization as outlined below:

INSPECTOR'S GUIDE

I. General
   - A. Level I Inspection Method Description
   - B. Level II Inspection Method Description
   - C. Level III Inspection Method Description

II. General Inspection
   - A. Process. This section describes the process of the inspection activity.
   - B. Location. This section describes the procedure for locating the inspection units in the facility or infrastructure on this installation.

III. Inspector Qualifications

This section notes the minimum qualifications for the person or persons performing the survey.

IV. Inspection Unit

This section describes how the IU (Inspection Unit) is determined for the particular component being surveyed.

V. Unit Costs

This section notes the nature of repair costs for this system.

VI. Standard Safety Requirements

This section lists safety procedures and equipment required to implement a safe environment for the conduct of this survey.

VII. Standard Tools

This section lists a set of standard tools required for the general conduct of this survey.

VIII. Special Tools and Equipment Requirements

This section refers to special tools or equipment requirements endemic to the nature of the system being surveyed.

30 WATER TREATMENT PLANTS

IX. Level II Inspection Method Keys
This section explains the use of keys as they relate to Level II Guide Sheets.

X. Level III Inspection Method Keys
This section explains the use of keys as they relate to Level III Guide Sheets.

XI. Replacement Cost
This section describes the nature and location of replacement cost data.

XII. Appendices
Appendix A. Provides a listing and definition of all abbreviations used both in the Standards and in the data base.

Appendix B. Provides a glossary of terms with their definitions as used in the Standard.

Appendix C. This section contains a listing of the average life cycle durations for each assembly* in the Standard.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

SYSTEM TREE

The System Tree is a graphical representation of the Work Breakdown Structure, showing system, subsystem and component relationships for the Water Treatment Plants.

INSPECTION METHODS

Description
Describes the nature of what is to be condition surveyed.

Special Tool and Equipment Requirements
Lists any special tools required for this specific subsystem.

Special Safety Requirements
This section outlines any special safety measures or equipment required for this specific subsystem so as to maintain a safe environment and process in the conduct of the condition survey.

Component List
All components to be surveyed under this subsystem are listed here.

Related Subsystems
All other subsystems that have a survey relationship to this subsystem are listed here to help coordinate a complete and thorough condition assessment survey.

30 WATER TREATMENT PLANTS

Standard Inspection Procedure

This statement indicates the various levels of survey effort required for this subsystem.

Components

The previously listed components of this subsystem are described with a survey procedure recommended on a component by component basis. For each component there is a listing of defects with each defect broken down into observations describing the nature and severity of the defective condition observed. The surveyor enters a quantification value for each defect/observation encountered in the field CAIS device (DCD) to record the result of his survey.

References

This page lists the reference sources from which the foregoing subsystem data was developed.

Guide Sheet Control Number

This section lists the key numbers that tie the written Level II and Level III guide sheets to specific components in this subsystem.

Level II and Level III Inspection Method Guide Sheets

This section contains the detailed descriptions of the Level II and III survey and inspection procedures for this subsystem.

30 WATER TREATMENT PLANTS

INSPECTOR'S GUIDE

I. GENERAL

A. Level I Inspection Method

The Level I Inspection Method of water treatment plants consists of a thorough inspection of each subsystem and component as described in the Work Breakdown Structure. Portions of the system may be inaccessible during the Level I inspection. Only readily accessible components need to be addressed during a Level I inspection. The survey activity is designed to be performed by a single surveyor.

B. Level II Inspection Method

Level II inspections are triggered by defect/observations noted at the Level I inspection or in some cases, are required to conduct a meaningful survey of the component being inspected. The Water Treatment Plants require very few Level II inspections, since most defects are readily apparent from a Level I. For instance, the investigation of grinding noises in a pump may dictate that a Level II inspection be performed. Level II inspections are referenced by defect/observations through a "Level II key", which denotes a specific Guide Sheet that describes the Level II inspection activity.

C. Level III Inspection Method

The Level III inspection is triggered by defect/observations occurring in the Level I and II inspections. The Level III inspection can also occur as a result of time based scheduling, antidotal experience, or component age compared to its life cycle. The Level III inspection is referenced through a Level III key which in turn, denotes a specific Guide Sheet describing the Level III inspection process and requirements. Level III inspections produce a detailed, written engineering assessment of the deficiency along with an estimated cost of correction, and are performed at the option of the Facility Manager.

II. GENERAL INSPECTION

A. Process

Surveys are normally conducted at the component level. Figure 30-A provides the breakdown from system through component for the Water Treatment Plants. The surveyor will work through the Work Breakdown Structure (WBS) to conduct the inspection. At the component level the surveyor will be provided a list of defects, each of which is described further in detail as observations. These observations are described to various levels of severity as they relate to the effect of the life of the system. The quantification of each deficiency is identified by the surveyor using the associated unit of measure. Once an observation is populated with a deficient quantity, the inspector will be requested to provide information on the component type and location. The installation date or age of the component may be preloaded into the WBS for each asset from the Real Property Inventory List or site specific information.

30 WATER TREATMENT PLANTS

If necessary, age data can be overridden by the surveyor, Site CAIS personnel, or the Facility Manager.

B. Location

Level I and II inspections will be located by the surveyor through a discrete entry in the Field CAIS. Building floor plans or sketches are required to ensure a complete inspection of all areas and to assist in the location of IU's. The inspection team members must use the recommended room numbering schemes for the installation. The installation may have rooms physically identified by a numbering system or identified on floor plans. If both exist and are different, the Facility Manager will develop guidance on which numbering system takes precedence. Where numbering systems do not exist or are not complete in identifying each space, specific guidance for the inspector to annotate areas in a consistent manner should be developed by the Facility Manager and implemented in the installations CAS process. In all cases, plans and maps shall be orientated with the top of each sheet being the north direction, so as to allow directional location and description. In the case where no other means of location exist the inspector shall enter a brief (65 character) description of location. Locations must be accurate to insure future repeatability and consistent results.

III. INSPECTOR QUALIFICATIONS

The minimum inspector qualification for the Water Treatment Plants requires a five year journeyman. All of the condition survey requirements for this system can be accomplished at the Level I inspection by a single inspector, however, safety and other considerations may require that inspectors work in teams. Inspectors will be specifically trained in the CAS system and its usage and will be CAS certified in the "Mechanical" discipline.

IV. INSPECTION UNIT (IU)

The Inspection Unit (IU) is normally defined at the component level for this system. The varied configurations of the components that exist in the Water Treatment Plants require that they be evaluated differently when defining the IU. Therefore, the measurement technique requires some consideration. If the inspector finds multiple defects that occur on the same IU, the inspector will quantify the observation that is considered most severe and identify the remaining quantity under the less severe observation for the discrete component. The IU's for the most common components would be defined as follows:

- Piping, fittings and valves - The IU is defined as the linear footage of the affected section of pipe containing the defect in a particular location (to include the fittings and valves along that section). For example, five sections of 2" DIA pipe extend the length of a 20' wall within a mechanical room. If the inspector were to observe 2 LF of bent pipe on one 20 LF section, the IU would be 20 LF, not the total amount of 2" DIA pipe in the room of 100 LF.

30 WATER TREATMENT PLANTS

- Pump IU, Gauge IU, Motor IU, etc. - Singularly defined items such as these are defined as each.

V. UNIT COSTS

The unit costs that are applied to the quantities recorded for each observation are contained within the Site CAIS as repair cost.

VI. STANDARD SAFETY REQUIREMENTS

The Master Safety Plan will be followed at all times during the condition survey.

Inspector may utilize the following protective gear:

- Hard hat - to be worn during all surveys
- Safety glasses - to be worn during all surveys
- Safety shoes - to be worn during all surveys
- Coveralls - to be worn as necessary
- Gloves - to be worn as necessary
- Ear plugs - to be worn in designated areas
- Knee pads - to be worn when crawling is required
- Rain suit - to be worn as necessary

VII. STANDARD TOOLS

Employee Identification Card - to be worn or carried during all survey activities
Data Collection Device (DCD)
Battery pack for DCD
Flashlight
Tape measure - 20' (or other supplemental measuring devices)
Screwdrivers - Phillips and straight slot
Pliers
Pocket knife or ice pick

VIII. SPECIAL TOOLS AND EQUIPMENT REQUIREMENTS

At the subsystem level, the deficiency standard has identified special tools and equipment required for the standard inspection of the associated components, which exceed the standard tools identified for the system. Level III Inspection Method Guide Sheets will address additional tools and equipment requirements that are specific to that particular advanced method of inspection.

Facility Managers should review these sections in order to determine any special tool requirements for subsystems they are to inspect/survey.

30 WATER TREATMENT PLANTS

IX. LEVEL II INSPECTION METHOD KEYS

Certain observations will reference a Level II Inspection Method. The Facility Manager will be able to identify deficiencies where a Level II inspection is flagged. The Level II key at the observation level will refer to a specific guide sheet.

All Level II Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

X. LEVEL III INSPECTION METHOD KEYS

Certain observations will trigger a Level III inspection. The Facility Manager will be able to identify deficiencies where a Level III inspection is flagged. The Level III Key at the observation level will refer to a specific guide sheet. These guide sheets may refer the Facility Manager to a more sophisticated and costly test method.

All Level III Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

XI. REPLACEMENT COST

A replacement cost for each subsystem type will be contained within the cost estimating system in the Site CAIS.

XII. APPENDICES

Appendix A - Abbreviations

A summary and definition of all abbreviations used in this system are contained in Appendix A which is located at the end of Water Treatment Plants.

Appendix B - Glossary

A glossary of terms used in this system are contained in Appendix B which is located at the end of Water Treatment Plants.

30 WATER TREATMENT PLANTS

Appendix C - Life Cycles

A listing of the average life cycle duration for each assembly* in the Standard.

Note - Facility Manager's Guide

The following are included in the Facility Manager's Guide:

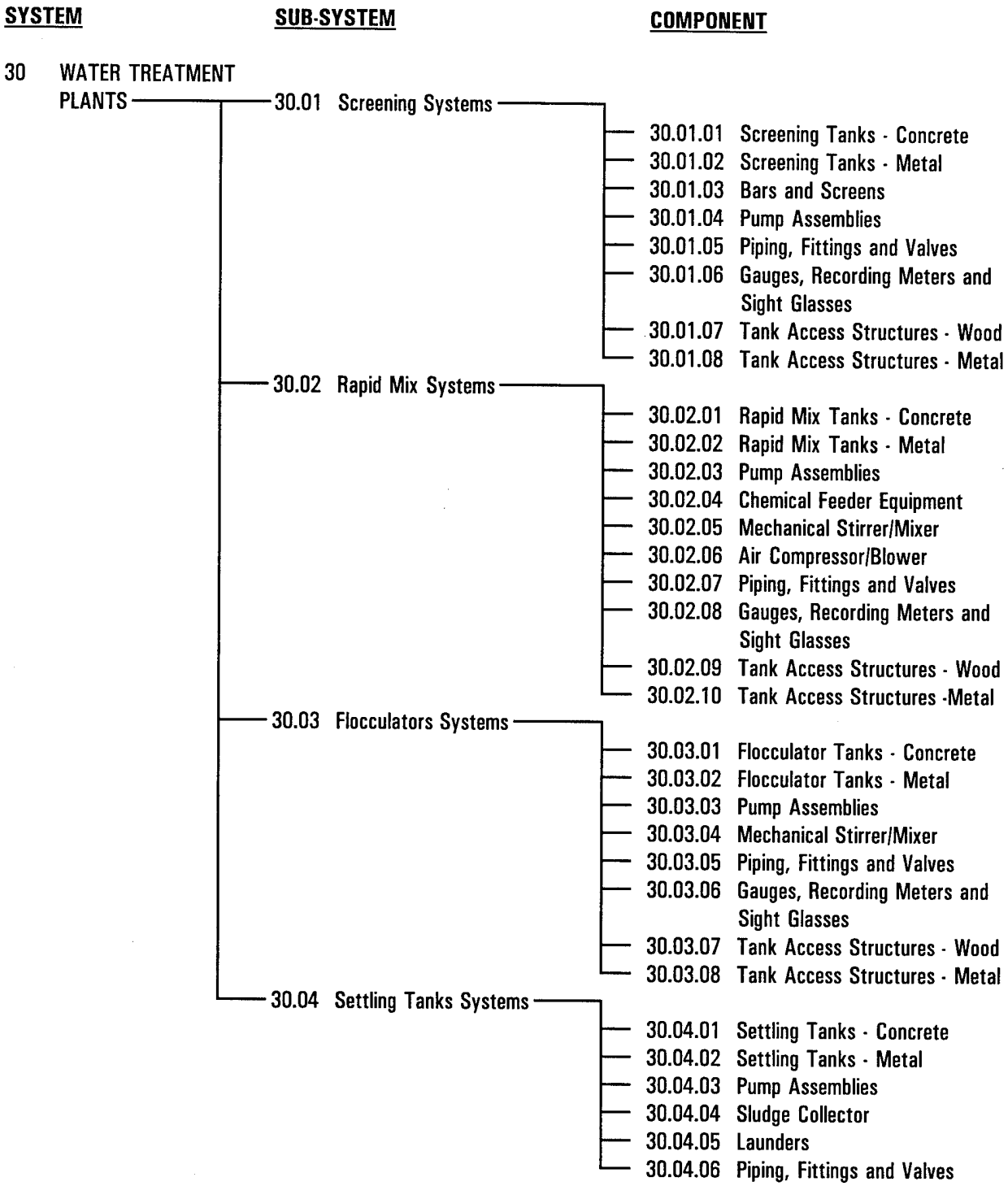
A table showing the required manhours to perform the standard inspection for this facility listed by Cat Code (three digit).

A listing of all Level III inspections with their estimated cost and time to perform. This list will include frequency of inspections for time driven Level III's.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

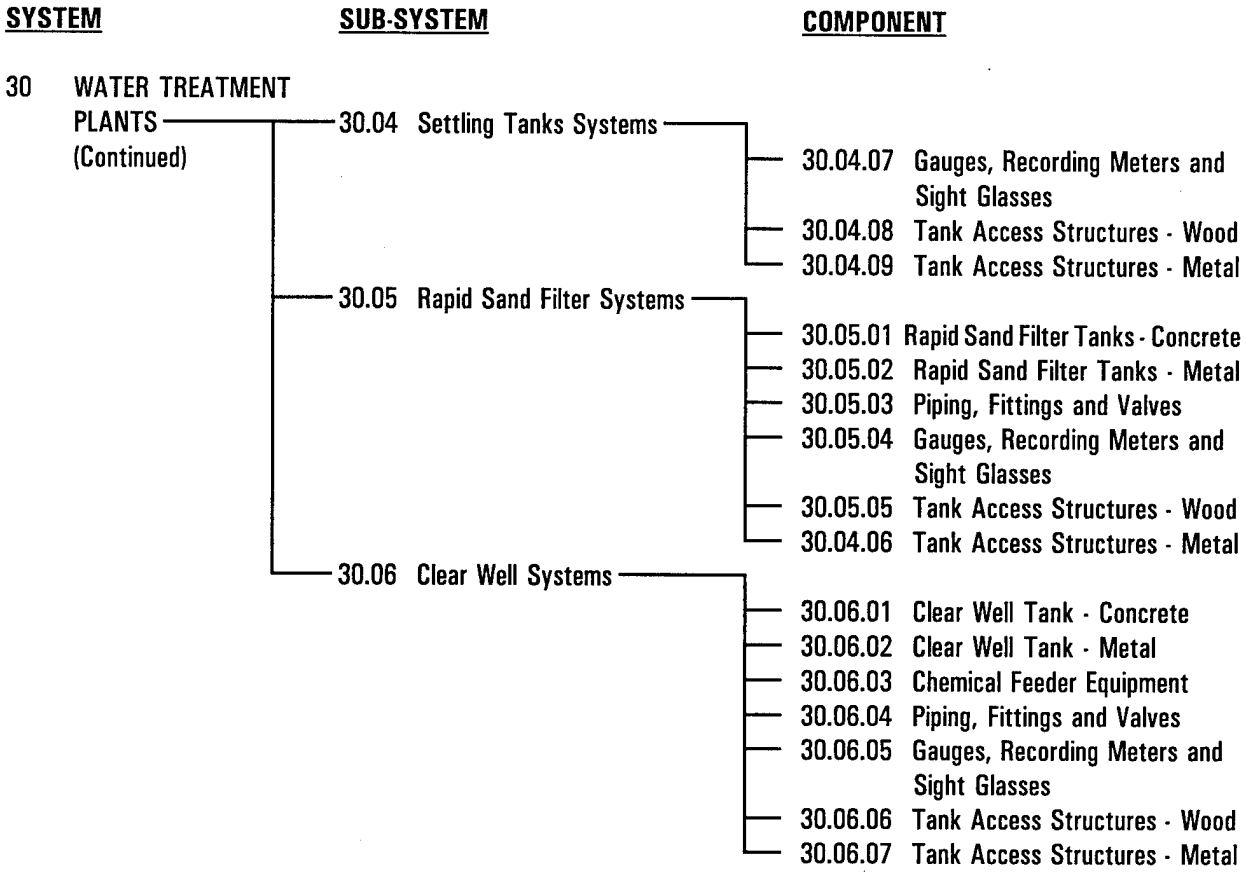
30 WATER TREATMENT PLANTS

Figure 30-A. WORK BREAKDOWN STRUCTURE



30 WATER TREATMENT PLANTS

Figure 30-A. WORK BREAKDOWN STRUCTURE (Continued)



30.01 SCREENING SYSTEMS

DESCRIPTION

Screening Systems is a subsystem of the Water Treatment Plants System. Water enters the screening tank from its source (wells, rivers, etc.) and is screened to collect foreign material (floating debris, fish, etc.) prior to treatment.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are required to perform the inspection of the Screening Systems:

1. Paintbrush
2. Dye penetrant

SPECIAL SAFETY REQUIREMENTS

The following list of special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of Screening Systems.

1. Arrangements for access to the area, prior to the performance of the inspection, shall be in accordance with applicable procedures.

COMPONENT LIST

- 30.01.01 SCREENING TANKS - CONCRETE
- 30.01.02 SCREENING TANKS - METAL
- 30.01.03 BARS AND SCREENS
- 30.01.04 PUMP ASSEMBLIES
- 30.01.05 PIPING, FITTINGS AND VALVES
- 30.01.06 GAUGES, RECORDING METERS AND SIGHT GLASSES
- 30.01.07 TANK ACCESS STRUCTURES - WOOD
- 30.01.08 TANK ACCESS STRUCTURES - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

23.01	POTABLE WATER DISTRIBUTION
23.02	NON-POTABLE WATER DISTRIBUTION
30.02	RAPID MIX SYSTEMS
30.03	FLOCCULATOR SYSTEMS
30.04	SETTLING SYSTEMS
30.05	RAPID SAND FILTERS
30.06	CLEAR WELL SYSTEMS

30.01 SCREENING SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

a. Use Level I inspection method if HP is less than 5.
b. Use Level I & II inspection methods if HP is 5 to 40.
c. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized pump and motors applications.

Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common defects to be noted include, cracked tank foundations, cracked/spalled concrete, rusting tank walls and mechanical equipment.

COMPONENTS

◆ 30.01.01 SCREENING TANKS - CONCRETE

The concrete screening tank provides a vessel for removing debris, vegetation, fish and other solid matter from the intake water. This is done by filtering through racks and screens. The tank is a reinforced concrete structure on a concrete base/foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ 30.01.01 SCREENING TANKS - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking.**			
Observation:			
a. Surface cracking, no signs of tank leakage.	LF		
*** {Severity L}			
b. Surface cracked, stains indicating fluid seepage.	LF		
*** {Severity M}			
c. Surface cracked, steady flowing leakage.	LF		1
*** {Severity H}			
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of member.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		2
*** {Severity H}			
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			
d. Exposure of reinforcing steel.	SF		2
*** {Severity H}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ 30.01.01 SCREENING TANKS - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	SF		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ 30.01.02 SCREENING TANKS - METAL

The bar rack and screens for filtering intake water may be installed in a metal tank. The tank is a steel structure usually mounted on a concrete foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			
*** Shell physical damage.**			
Observation:			
a. Dents and abrasions, no leakage or visible effect on tank operation.	SF		
*** {Severity L}			
b. Dents and abrasions, evidence of leakage (stains).	SF		
*** {Severity M}			
c. Dents and abrasions, steady fluid leakage.	SF		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners, evidence of leakage.	EA		
*** {Severity H}			
b. Cracked or broken welds, evidence of leakage.	EA		
*** {Severity H}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ **30.01.02 SCREENING TANKS - METAL (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated protective covering/corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ 30.01.03 BARS AND SCREENS

Screening devices for intake water include bar racks and screens. The bar racks with 1 1/2" to 2" openings keep large floating debris out of intake conduits. The screens (coarse 1" mesh to fine 1/4" mesh) remove smaller floating debris, vegetation, fish and other solid matter.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physically damaged bar racks.**			
Observation:			
a. Cracked or broken bars affecting less than or equal to 10 percent of rack area.	SF		
*** {Severity M}			
b. Broken or missing bars, affected greater than 10 percent of rack area.	SF		
*** {Severity H}			
*** Physically damaged screens.**			
Observation:			
a. Torn or elongated mesh coarse screens less than or equal to 10 percent of screen area.	SF		
*** {Severity M}			
b. Torn or elongated mesh coarse screens greater than 10 percent of screen area.	SF		
*** {Severity H}			
c. Missing screens.	SF		
*** {Severity H}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ 30.01.04 PUMP ASSEMBLIES

Pumps facilitate the movement of water influent through the screening facilities. The pump unit includes pump, motor, drive, wiring and controls.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump.**			
Observation:			
a. Cracked or damaged pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
*** Excessive pump noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	3
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	3
*** {Severity H}			
*** Broken/loose pump hardware.**			
Observation:			
a. Loose pump assembly or mounting bolts.	EA		
*** {Severity L}			
b. Broken or missing pump assembly or mounting bolts.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Leaking pump housing.	EA		
*** {Severity M}			
b. Leaking or damaged pump seals.	EA		
*** {Severity M}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ **30.01.04 PUMP ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Excessive motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	4
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	4
*** {Severity H}			
c. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ 30.01.04 **PUMP ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Pump drive defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Missing coupling or belt guard.	EA		
*** {Severity H}			
*** Float control hardware defects.**			
Observation:			
a. Loose deformed or binding linkage.	EA		
*** {Severity M}			
b. Inoperable float control mechanism.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ 30.01.05 PIPING, FITTINGS AND VALVES

Piping, fittings and valves are used to transfer the screened water supply to the treatment plant facility for further processing.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Bent or cracked fittings, leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Bent or cracked pipe, leaking.	LF		
*** {Severity H}			
*** Loose/missing supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Leaking valve.**			
Observation:			
a. Leaking check valve.	EA		
*** {Severity L}			
b. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ 30.01.05 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged valve.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem, valve operable.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Bent stem and/or valve inoperable.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ 30.01.06 GAUGES, RECORDING METERS AND SIGHT GLASSES

Gauges, recording meters and sight glasses are utilized to monitor the plant operations, pressures, flow and levels throughout the component system as it affects the overall plant function. The devices vary significantly in size and mechanical operation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Gauge defects.**			
Observation:			
a. Moisture behind lens.	EA		
*** {Severity L}			
b. Dial face not readable.	EA		
*** {Severity H}			
c. Lens broken.	EA		
*** {Severity H}			
d. Gauges inoperative.	EA		
*** {Severity H}			
*** Recording meter defects.**			
Observation:			
a. Housing corroded.	EA		
*** {Severity L}			
b. Lens broken.	EA		
*** {Severity M}			
c. Damaged or missing pen holders.	EA		
*** {Severity H}			
d. Recording device inoperable.	EA		
*** {Severity H}			
*** Sight glass defects.**			
Observation:			
a. Rust on inside of sight glass.	EA		
*** {Severity L}			
b. Sight glass, graduations not readable.	EA		
*** {Severity M}			
c. Sight glass broken.	EA		
*** {Severity H}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ 30.01.07 TANK ACCESS STRUCTURES - WOOD

Wood tank access structures include wooden stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage defects.**			
Observation:			
a. Wood surface fibers separated, less than or equal to 25 percent of the thickness affected.	LF		
*** {Severity M}			
b. Wood surface fibers separated, greater than 25 percent of the thickness affected.	LF		
*** {Severity H}			
c. Structural member deformed, broken or missing.	LF		
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Rot, fungus or decay.**			
Observation:			
a. Moist stained area.	LF		
*** {Severity M}			
b. Discolored, soft or crushed area.	LF		
*** {Severity H}			
*** Parasite damage.**			
Observation:			
a. Holes less than 1/8" DIA, surface sag, frass observed.	LF		
*** {Severity M}			
b. Large holes greater than 1/8" DIA, surface channels, punctures, and crushing.	LF		
*** {Severity H}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ **30.01.07 TANK ACCESS STRUCTURES - WOOD (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connections/anchorage.**			
Observation:			
a. Loose connections/anchorage.	EA		
*** {Severity M}			
b. Broken, split, or damaged connections.	EA		
*** {Severity H}			

30.01 SCREENING SYSTEMS

COMPONENTS (Continued)

◆ 30.01.08 TANK ACCESS STRUCTURES - METAL

Metal tank access structures include metal stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage, cracking and buckling.**			
Observation:			
a. Impact damage, dents, bends, not affecting safety or function.	LF		
*** {Severity M}			
b. Deformation, twisting or bending from overload.	LF		
*** {Severity H}			
c. Stress or fatigue cracks in members.	LF	2	
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners.	EA		
*** {Severity M}			
b. Cracked or broken welds.	EA	2	
*** {Severity H}			
c. Missing bolts or fasteners.	EA		
*** {Severity H}			
d. Impact damage, broken brackets.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

30.01 SCREENING SYSTEMS

REFERENCES

1. NAVFAC DM-5.7, Civil Engineer Water Supply Systems, 1979

2. Environment Engineering, 1982, Butterworth Publisher

3. Structural Handbook Civil Engineers, 1983

4. Utilities Supply Contract 2470-86C-7200, U.S. Naval Station, Miami, FL

5. Division Water Supply Engineering, Williamsburg, VA

6. American Water Works Association, Water Main Evaluation for Rehabilitation/Replacement, 1986

7.* Maintenance Planning and Scheduling, Water Department, Cape Charles, VA 1994

8.* Chesapeake Water Treatment, TRIBUL-FLEX PM Schedule, Chesapeake, VA, 1994

9. McMaster-Carr Catalog, 1994

* Documents and personal tours.

30.01 SCREENING SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 30.01.04-1
2	GS-II 30.01.08-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 30.01.01-1
2	GS-III 30.01.01-2
3	GS-III 30.01.04-3
4	GS-III 30.01.04-4
5	GS-III 30.01.04-5

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-II 30.01.04-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: TANK ACCESS STRUCTURES - METAL
CONTROL NUMBER: GS-II 30.01.08-2

Application

This guide applies to the investigation of cracks or cracked welds in metal ladders.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: SCREENING TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.01.01-1

Application

This guide applies to the investigation of cracks in the concrete screening tank.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: SCREENING TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.01.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter H. Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.01.04-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion; check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers (pistons) for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: PUMP ASSEMBLES
CONTROL NUMBER: GS-III 30.01.04-3

Inspection Actions (Continued)

15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2 Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.01.04-4

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing outside when someone is working inside a walk-in unit.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.01.04-4

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: PUMP ASSEMBLES
CONTROL NUMBER: GS-III 30.01.04-5

Application

This guide applies to the investigation of electrical arcing noise from the pump motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing outside when someone is working inside a walk-in unit.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: PUMP ASSEMBLES
CONTROL NUMBER: GS-III 30.01.04-5

Inspection Actions (Continued)

13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

30.02 RAPID MIX SYSTEMS

DESCRIPTION

Rapid Mix Systems is a subsystem of the Water Treatment Plant System. The Rapid Mix System involves the mixing of chemicals to the screened water to promote flocculation and sedimentation.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Rapid Mix Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following list of special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of Rapid Mix System.

1. Arrangements for access to the area, prior to the performance of the inspection,

2. Inspectors should utilize the installations notification procedures to secure safe access to the areas of chemical injections and storage especially in the areas of chlorination.

COMPONENT LIST

- 30.02.01 RAPID MIX TANKS - CONCRETE
- 30.02.02 RAPID MIX TANKS - METAL
- 30.02.03 PUMP ASSEMBLIES
- 30.02.04 CHEMICAL FEEDER EQUIPMENT
- 30.02.05 MECHANICAL STIRRER/MIXER
- 30.02.06 AIR COMPRESSOR/BLOWER
- 30.02.07 PIPING, FITTINGS AND VALVES
- 30.02.08 GAUGES, RECORDING METERS AND SIGHT GLASSES
- 30.02.09 TANK ACCESS STRUCTURES - WOOD
- 30.02.10 TANK ACCESS STRUCTURES - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

23.01	POTABLE WATER DISTRIBUTION
30.01	SCREENING SYSTEMS
30.03	FLOCCULATOR SYSTEMS
30.04	SETTLING SYSTEMS
30.05	RAPID SAND FILTERS
30.06	CLEAR WELL SYSTEMS

30.02 RAPID MIX SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

a. Use Level I inspection method if HP is less than 5.
b. Use Level I & II inspection methods if HP is 5 to 40.
c. Use Level I, II and/or III inspection methods if HP is greater than 40.

For fans, blower assemblies in general use, Level I & II inspection methods will apply. No Level III inspection will be required.

The Facility Manager will specify the level of inspection required for specialized pump and motors applications.

Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common defects to be noted include, cracked tank foundations, cracked/spalled concrete, rusting tank walls and mechanical equipment, unequal air distribution and inoperable foam spray nozzles.

30.02 RAPID MIX SYSTEMS

COMPONENTS

◆ 30.02.01 RAPID MIX TANK - CONCRETE

The rapid (flash) mix tank is a vessel where chemicals are rapidly mixed with the water influent from the screening tank to promote flocculation and sedimentation. The tank is a reinforced concrete structure on a concrete base/foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			
*** Cracking.**			
Observation:			
a. Surface cracking, no signs of tank leakage.	LF		
*** {Severity L}			
b. Surface cracked, stains indicating fluid seepage.	LF		
*** {Severity M}			
c. Surface cracked, steady flowing leakage.	LF		1
*** {Severity H}			
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of member.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		2
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ **30.02.01 RAPID MIX TANKS - CONCRETE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			
d. Exposure of reinforcing steel.	SF		2
*** {Severity H}			
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	SF		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ 30.02.02 RAPID MIX TANKS - METAL

The rapid (flash) mix tank is a vessel where chemicals are rapidly mixed with the water influent from the screening tank to promote flocculation and sedimentation. The tank is a steel structure usually mounted on a concrete foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			
*** Shell physical damage.**			
Observation:			
a. Dents and abrasions, no leakage or visible effect on tank operation.	SF		
*** {Severity L}			
b. Dents and abrasions, evidence of leakage (stains).	SF		
*** {Severity M}			
c. Dents and abrasions, steady fluid leakage.	SF		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners, evidence of leakage.	EA		
*** {Severity H}			
b. Cracked or broken welds, evidence of leakage.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ **30.02.02 RAPID MIX TANKS - METAL (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated protective covering/corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ 30.02.03 PUMP ASSEMBLIES

Pumps facilitate the movement of water through the rapid mix tank. The pump unit includes pump, motor, drive, wiring and controls.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump.**			
Observation:			
a. Cracked pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
*** Excessive pump noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	3
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	3
*** {Severity H}			
*** Broken/loose pump hardware.**			
Observation:			
a. Loose pump assembly or mounting bolts.	EA		
*** {Severity L}			
b. Broken or missing pump assembly or mounting bolts.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a Leaking pump housing.	EA		
*** {Severity M}			
b. Leaking or damaged pump seals.	EA		
*** {Severity M}			
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ 30.02.03 PUMP ASSEMBLIES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Excessive motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	4
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	4
*** {Severity H}			
c. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity S}			
*** Pump drive defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Missing coupling.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ **30.02.03 PUMP ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Float control hardware defects.**			
Observation:			
a. Loose deformed or binding linkage.	EA		
*** {Severity M}			
b. Inoperable float control mechanism.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ 30.02.04 CHEMICAL FEEDER EQUIPMENT

Chemical feeders are devices for the insertion of various solid and gaseous chemicals into the water for flocculation, disinfection and removal of undesirable minerals and organic matter. The equipment includes slakers, mixers, proportioning pumps, piping/tubing, mix controls, and storage hoppers and cylinders.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hopper defects.**			
Observation:			
a. Bent/deformed, still operable.	SF		
*** {Severity L}			
b. Damaged/missing covers.	EA		
*** {Severity M}			
c. Loose/missing mounting hardware.	EA		
*** {Severity M}			
d. Cracked/open shell leaking.	EA		
*** {Severity H}			
*** Slaker defects.**			
Observation:			
a. Damaged/missing covers.	EA		
*** {Severity L}			
b. Missing/damaged spray nozzles less than or equal to 10 percent of total.	EA		
*** {Severity M}			
c. Loose/missing mounting hardware.	EA		
*** {Severity H}			
d. Missing/damaged spray nozzles greater than 10 percent of total.	EA		
*** {Severity H}			
e. Noisy slaker bearings.	EA		
*** {Severity H}			
f. Noisy slaker motor and/or drive.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ **30.02.04 CHEMICAL FEEDER EQUIPMENT (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Mixing vat defects.**			
Observation:			
a. Missing/damaged cover.	EA		
*** {Severity M}			
b. Loose/missing mounting hardware.	EA		
*** {Severity M}			
c. Noisy stirring/agitator motor and/or drive.	EA		
*** {Severity H}			
*** Cylinder storage defects.**			
Observation:			
a. Loose/missing cylinder securing devices chains/straps.	EA		
*** {Severity M}			
b. Missing cylinder labeling.	EA		
*** {Severity M}			
c. Chlorine odor - indicating leaking cylinder valve.	EA		
*** {Severity H}			
d. Damaged or improper fusible plug in cylinder valve.	EA		
*** {Severity H}			
*** Instrumentation/control defects.**			
Observation:			
a. Corroded flow control device, still. operable.	EA		
*** {Severity M}			
b. Damaged/missing/inoperable flow control device.	EA		
*** {Severity H}			
c. Chlorine odor - indicating instrumentation leakage.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ **30.02.04 CHEMICAL FEEDER EQUIPMENT (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Piping, fittings and valve defects.**			
Observation:			
a. Corrosion evident by minor pitting.	LF		
*** {Severity M}			
b. Corrosion evident by blistering, severe pitting.	LF		
*** {Severity H}			
c. Chlorine odor - indicating leak at fitting or valve.	LF		
*** {Severity H}			
d. Frayed or damaged flexible piping from cylinder to manifold piping.	LF		
*** {Severity H}			
e. Damaged or missing pipe insulation.	LF		
*** {Severity F}			
f. Debris or storage blocking access to cylinders or equipment.	LF		
*** {Severity S}			
g. Missing/illegible pipe labeling.	LF		
*** {Severity S}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ 30.02.05 MECHANICAL STIRRER/MIXER

Mechanical agitation is provided to disperse chemicals applied and to entrap colloids. The unit normally consists of a motor, coupling, gear box, shaft and paddles.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged motor/gear box.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken base.	EA		
*** {Severity H}			
*** Broken/loose motor/gear box hardware.**			
Observation:			
a. Loose assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing inspection covers.	EA		
*** {Severity M}			
c. Broken or missing assembly bolts.	EA		
*** {Severity H}			
*** Excessive noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	
*** {Severity H}			
c. Electrical arcing noise.	EA	2	
*** {Severity H}			
*** Loose/damaged coupling or shaft.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
c. Defective coupling.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ 30.02.05 MECHANICAL STIRRER/MIXER (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Loose/missing coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing coupling guard.	EA		
*** {Severity H}			
*** Defective paddles.**			
Observation:			
a. Chemical build-up on paddles	EA		
*** {Severity M}			
b. Broken or eroded.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evident by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evident by holes or loss of base metal.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ 30.02.06 AIR COMPRESSOR/BLOWER

The compressor/blower provides pressurized air through diffusers or nozzles at the bottom of the rapid mix tank.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive compressor/blower noise and vibration.**			
Observation:			
a. Rattling noise.	EA	3	6
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	3	6
*** {Severity H}			
c. Clicking or slapping noise.	EA	3	6
*** {Severity H}			
*** Defective compressor/blower mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged hardware or supports.	EA		
*** {Severity M}			
c. Missing hardware or supports.	EA		
*** {Severity H}			
*** Leaking air tank, piping, fittings and valves.**			
Observation:			
a. Leaking valve packing glands/seals, evidenced by leaking air.	EA		
*** {Severity M}			
b. Damaged piping, fittings or valves.	EA		
*** {Severity H}			
c. Stress cracks in tank, evidenced by leaking air.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ **30.02.06 AIR COMPRESSOR/BLOWER (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Broken/loose compressor/blower assembly bolts.**			
Observation:			
a. Loose compressor or motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing compressor or motor assembly bolts.	EA		
*** {Severity H}			
*** Loose compressor/blower base.**			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity L}			
b. Missing base tie-down bolts or isolators.	EA		
*** {Severity H}			
*** Defective pressure gauge.**			
Observation:			
a. Broken gauge or gauge lens.	EA		
*** {Severity L}			
b. Leaking pressure gauge.	EA		
*** {Severity M}			
*** Damaged compressor/blower motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ **30.02.06 AIR COMPRESSOR/BLOWER (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Compressor/blower drive defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Missing coupling.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ 30.02.07 PIPING, FITTINGS AND VALVES

Piping, fittings and valves are used to transfer and route the treated fluids to the various plant functions and to provide the water supply to the rapid mix tank foam control spray system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Spray system domestic water dripping.	EA		
*** {Severity L}			
c. Treated water dripping.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Spray system domestic water dripping.	LF		
*** {Severity L}			
c. Treated water dripping.	LF		
*** {Severity H}			
*** Loose/missing supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Leaking valve.**			
Observation:			
a. Leaking check valve.	EA		
*** {Severity L}			
b. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ **30.02.07 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged valve.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem, valve operable.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Bent stem and/or valve inoperable.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ 30.02.08 GAUGES, RECORDING METERS AND SIGHT GLASSES

Gauges, recording meters and sight glasses are utilized to monitor the plant operations, pressures, flow and levels throughout the component system as it affects the overall plant function. The devices vary significantly in size and mechanical operation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Gauge defects.**			
Observation:			
a. Moisture behind lens.	EA		
*** {Severity L}			
b. Dial face not readable.	EA		
*** {Severity H}			
c. Lens broken.	EA		
*** {Severity H}			
d. Gauges inoperative.	EA		
*** {Severity H}			
*** Recording meter defects.**			
Observation:			
a. Housing corroded.	EA		
*** {Severity L}			
b. Lens broken.	EA		
*** {Severity M}			
c. Damaged or missing pen holders.	EA		
*** {Severity H}			
d. Recording device inoperable.	EA		
*** {Severity H}			
*** Sight glass defects.**			
Observation:			
a. Rust on inside of sight glass.	EA		
*** {Severity L}			
b. Sight glass, graduations not readable.	EA		
*** {Severity M}			
c. Sight glass broken.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ 30.02.09 TANK ACCESS STRUCTURES - WOOD

Wood tank access structures include wooden stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage defects.**			
Observation:			
a. Wood surface fibers separated, less than or equal to 25 percent of the thickness affected.	LF		
*** {Severity M}			
b. Wood surface fibers separated, greater than 25 percent of the thickness affected.	LF		
*** {Severity H}			
c. Structural member deformed, broken or missing.	LF		
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Rot, fungus or decay.**			
Observation:			
a. Moist stained area.	LF		
*** {Severity M}			
b. Discolored, soft or crushed area.	LF		
*** {Severity H}			
*** Parasite damage.**			
Observation:			
a. Holes less than 1/8" DIA, surface sag, frass observed.	LF		
*** {Severity M}			
b. Large holes greater than 1/8" DIA, surface channels, punctures, and crushing.	LF		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ **30.02.09 TANK ACCESS STRUCTURES - WOOD (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connections/anchorage.**			
Observation:			
a. Loose connections/anchorage.	EA		
*** {Severity M}			
b. Broken, split, or damaged connections.	EA		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

COMPONENTS (Continued)

◆ 30.02.10 TANK ACCESS STRUCTURES - METAL

Metal tank access structures include metal stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage, cracking and buckling.**			
Observation:			
a. Impact damage, dents, bends, not affecting safety or function.	LF		
*** {Severity M}			
b. Deformation, twisting or bending from overload.	LF		
*** {Severity H}			
c. Stress or fatigue cracks in members.	LF	4	
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners.	EA		
*** {Severity M}			
b. Cracked or broken welds.	EA	4	
*** {Severity H}			
c. Missing bolts or fasteners.	EA		
*** {Severity H}			
d. Impact damage, broken brackets.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

30.02 RAPID MIX SYSTEMS

REFERENCES

1. NAVFAC DM-5.7, Civil Engineer Water Supply Systems, 1979

2. Environment Engineering, 1982, Butterworth Publisher

3. Structural Handbook Civil Engineers, 1983

4. Utilities Supply Contract 2470-86C-7200, U.S. Naval Station, Miami, FL

5. Division Water Supply Engineering, Williamsburg, VA

6. American Water Works Association, Water Main Evaluation for Rehabilitation/ Replacement, 1986

* 7. Maintenance Planning and Scheduling, Water Department, Cape Charles, VA 1994

* 8 Chesapeake Water Treatment, TRIBUL-FLEX PM Schedule, Chesapeake, VA, 1994

9. McMaster-Carr Catalog, 1994

* Documents and personal tours.

30.02 RAPID MIX SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 30.02.03-1
2	GS-II 30.02.05-2
3	GS-II 30.02.06-3
4	GS-II 30.02.10-4

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 30.02.01-1
2	GS-III 30.02.01-2
3	GS-III 30.02.03-3
4	GS-III 30.02.03-4
5	GS-III 30.02.03-5
6	GS-III 30.02.06-6

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-II 30.02.03-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: MECHANICAL STIRRER/MIXER
CONTROL NUMBER: GS-II 30.02.05-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor or gear box in a mechanical stirrer/mixer.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: MECHANICAL STIRRER/MIXER
CONTROL NUMBER: GS-II 30.02.05-2

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: AIR COMPRESSOR/BLOWER
CONTROL NUMBER: GS-II 30.02.06-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the air compressor/blowers.

For air compressor and blower assemblies in general use, Level I and II inspection methods will apply. No Level III inspection will be required.

The Facility Manager will specify the level of inspection required for specialized fans, blowers or blower assemblies.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe operation and determine possible source of noise.
2. Shut down, tag and lock out disconnect.
3. Remove access plates.
4. Check assembly for wear, damage or loose fasteners.
5. Visually inspect blading for foreign objects and deposit buildup.
6. Inspect blading for cracks, fatigue, physical damage and corrosion.
7. Rotate shafting and check for distortion in shaft.
8. Rotate to check for binding.
9. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
10. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: TANK ACCESS STRUCTURES - METAL
CONTROL NUMBER: GS-II 30.02.10-4

Application

This guide applies to the investigation of cracks or cracked welds in metal ladders.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: RAPID MIX TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.02.01-1

Application

This guide applies to the investigation of cracks in concrete tanks.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: RAPID MIX TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.02.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Inspect exposed reinforcing rod to determine extent of visual corrosion.
4. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter H. Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.02.03-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion; check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers (pistons) for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.02.03-3

Inspection Actions (Continued)

15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2 Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.02.03-4

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.02.03-4

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.02.03-5

Application

This guide applies to the investigation of electrical arcing noise from the pump motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.02.03-5

Inspection Actions (Continued)

13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: AIR COMPRESSOR/BLOWERS
CONTROL NUMBER: GS-III 30.02.06-6

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the compressor motor.

For air compressors and blowers in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion; check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: AIR COMPRESSOR/BLOWERS
CONTROL NUMBER: GS-III 30.02.06-6

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

30.03 FLOCCULATOR SYSTEMS

DESCRIPTION

Flocculator Systems is a subsystem of the Water Treatment Plant Systems. Flocculation is a process of coagulation to remove suspended particles from the water. The Flocculation System contains pipes, pumps, tanks and foam control spray system.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tools Section, are needed to perform the inspection of Flocculator Systems:

1. Dye, paintbrush, developer and rags

SPECIAL SAFETY REQUIREMENTS

The following list of special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of Flocculator Systems.

1. Inspectors should utilize the installations notification procedures to secure safe access to the areas of chemical injections and storage especially in the areas of chlorination.

COMPONENT LIST

- 30.03.01 FLOCCULATOR TANKS - CONCRETE
- 30.03.02 FLOCCULATOR TANKS - METAL
- 30.03.03 PUMP ASSEMBLIES
- 30.03.04 MECHANICAL STIRRER/MIXER
- 30.03.05 PIPING, FITTINGS AND VALVES
- 30.03.06 GAUGES, RECORDING METERS AND SIGHT GLASSES
- 30.03.07 TANK ACCESS STRUCTURES - WOOD
- 30.03.08 TANK ACCESS STRUCTURES - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

23.01	POTABLE WATER DISTRIBUTION
30.01	SCREENING SYSTEMS
30.02	RAPID-MIX SYSTEMS
30.04	SETTLING SYSTEMS
30.05	RAPID SAND FILTERS
30.06	CLEAR WELL SYSTEMS

30.03 FLOCCULATOR SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

a. Use Level I inspection method if HP is less than 5.
b. Use Level I & II inspection methods if HP is 5 to 40.
c. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized pump and motors applications.

Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common defects to be noted include cracked tank foundations, cracked/spalled concrete, rusting tank walls and mechanical equipment, unequal air distribution and inoperative foam spray nozzles.

COMPONENTS

◆ 30.03.01 FLOCCULATOR TANKS - CONCRETE

The flocculation tank provides a vessel in which the suspended solids are transformed into a settlable floc prior to entering the settling tank. The tank is a reinforced concrete structure on a concrete base/foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, exposed reinforcing and/or piping deformed.	SF		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ **30.03.01 FLOCCULATOR TANKS - CONCRETE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking.**			
Observation:			
a. Surface cracking, no signs of tank leakage.	LF		
*** {Severity L}			
b. Surface cracked, stains indicating fluid seepage.	LF		
*** {Severity M}			
c. Surface cracked, steady flowing leakage.	LF		1
*** {Severity H}			
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of member.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		2
*** {Severity H}			
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			
d. Exposure of reinforcing steel.	SF		2
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ 30.03.01 FLOCCULATOR TANKS - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	SF		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ 30.03.02 FLOCCULATOR TANKS - METAL

The flocculation tank provides a vessel in which the suspended solids are transformed into a settlable floc prior to entering the settling tank. The tank is a steel structure on a concrete base/foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, exposed reinforcing and/or piping deformed.	SF		
*** {Severity H}			
*** Shell physical damage.**			
Observation:			
a. Dent and abrasions, no leakage or visible effect on tank operation.	SF		
*** {Severity L}			
b. Dents and abrasions, evidence of leakage (stains).	SF		
*** {Severity M}			
c. Dents and abrasions, steady fluid leakage.	SF		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners, evidence of leakage.	EA		
*** {Severity H}			
b. Cracked or broken welds, evidence of leakage.	EA		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ 30.03.02 FLOCCULATOR TANKS - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated protective covering/corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ 30.03.03 PUMP ASSEMBLIES

Pumps facilitate the movement of water influent through the flocculation process. The pump unit includes pump, motor, drive, wiring and controls.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump.**			
Observation:			
a. Cracked pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
*** Excessive pump noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	3
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	3
*** {Severity H}			
*** Broken/loose pump hardware.**			
Observation:			
a. Loose pump assembly or mounting bolts.	EA		
*** {Severity L}			
b. Broken or missing pump assembly or mounting bolts.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	EA		
*** {Severity L}			
b. Damaged or deteriorated insulation.	EA		
*** {Severity M}			
c. Missing insulation.	EA		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ **30.03.03 PUMP ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Leaking pump housing.	EA		
*** {Severity M}			
b. Leaking or damaged pump seals.	EA		
*** {Severity M}			
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Excessive motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	4
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	4
*** {Severity H}			
c. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ **30.03.03 PUMP ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Pump drive defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Loose, damaged or deformed coupling.	EA		
*** {Severity H}			
e. Missing coupling.	EA		
*** {Severity H}			
*** Float control hardware defects.**			
Observation:			
a. Loose deformed or binding linkage.	EA		
*** {Severity M}			
b. Inoperable float control mechanism.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ 30.03.04 MECHANICAL STIRRER/MIXER

Mechanical agitation is provided to disperse chemicals applied and to entrap colloids. The unit normally consists of a motor, coupling, gear box, shaft and paddles.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged motor/gear box.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken base.	EA		
*** {Severity H}			
*** Broken/loose motor/gear box hardware.**			
Observation:			
a. Loose assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing inspection covers.	EA		
*** {Severity M}			
c. Broken or missing assembly bolts.	EA		
*** {Severity H}			
*** Excessive noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	
*** {Severity H}			
c. Electrical arcing noise.	EA	2	
*** {Severity H}			
*** Loose/damaged coupling or shaft.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
c. Defective coupling.	EA		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ **30.03.04 MECHANICAL STIRRER/MIXER (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Loose/missing coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing coupling guard.	EA		
*** {Severity H}			
*** Defective paddles.**			
Observation:			
a. Chemical build-up on paddles.	EA		
*** {Severity M}			
b. Broken or eroded.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evident by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evident by holes or loss of base metal.	EA		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ 30.03.05 PIPING, FITTINGS AND VALVES

Piping, fittings and valves are used to transfer the treated water to the settling tanks and provide the water supply to the foam control spray system

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Spray system domestic water dripping.	EA		
*** {Severity L}			
c. Treated water leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Spray system domestic water dripping.	LF		
*** {Severity L}			
c. Treated water leaking.	LF		
*** {Severity H}			
*** Loose/missing supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Leaking valve.**			
Observation:			
a. Leaking check valve.	EA		
*** {Severity L}			
b. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ **30.03.05 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged valve.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem, valve operable.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Bent stem and/or valve inoperable.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ 30.03.06 GAUGES, RECORDING METERS AND SIGHT GLASSES

Gauges, recording meters and sight glasses are utilized to monitor the plant operations, pressures, flow and levels throughout the component system as it affects the overall plant function. The devices vary significantly in size and mechanical operation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Gauge defects.**			
Observation:			
a. Moisture behind lens.	EA		
*** {Severity L}			
b. Dial face not readable.	EA		
*** {Severity H}			
c. Lens broken.	EA		
*** {Severity H}			
d. Gauges inoperative.	EA		
*** {Severity H}			
*** Recording meter defects.**			
Observation:			
a. Housing corroded.	EA		
*** {Severity L}			
b. Lens broken.	EA		
*** {Severity M}			
c. Damaged or missing pen holders.	EA		
*** {Severity H}			
d. Recording device inoperable.	EA		
*** {Severity H}			
*** Sight glass defects.**			
Observation:			
a. Rust on inside of sight glass.	EA		
*** {Severity L}			
b. Sight glass graduations not readable.	EA		
*** {Severity M}			
c. Sight glass broken.	EA		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ 30.03.07 TANK ACCESS STRUCTURES - WOOD

Wood tank access structures include wooden stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage defects.**			
Observation:			
a. Wood surface fibers separated, less than or equal to 25 percent of the thickness affected.	LF		
*** {Severity M}			
b. Wood surface fibers separated, greater than 25 percent of the thickness affected.	LF		
*** {Severity H}			
c. Structural member deformed, broken or missing.	LF		
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Rot, fungus or decay.**			
Observation:			
a. Moist stained area.	LF		
*** {Severity M}			
b. Discolored, soft or crushed area.	LF		
*** {Severity H}			
*** Parasite damage.**			
Observation:			
a. Holes less than 1/8" DIA, surface sag, frass observed.	LF		
*** {Severity M}			
b. Large holes greater than 1/8" DIA, surface channels, punctures, and crushing.	LF		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose connections/anchorage.	EA		
*** {Severity M}			
b. Broken, split, or damaged connections.	EA		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

COMPONENTS (Continued)

◆ 30.03.08 TANK ACCESS STRUCTURES - METAL

Metal tank access structures include metal stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage, cracking and buckling.**			
Observation:			
a. Impact damage, dents, bends, not affecting safety or function.	LF		
*** {Severity M}			
b. Deformation, twisting or bending from overload.	LF		
*** {Severity H}			
c. Stress or fatigue cracks in members.	LF	3	
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners.	EA		
*** {Severity M}			
b. Cracked or broken welds.	EA	3	
*** {Severity H}			
c. Missing bolts or fasteners.	EA		
*** {Severity H}			
d. Impact damage, broken brackets.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

30.03 FLOCCULATOR SYSTEMS

REFERENCES

1. NAVFAC DM-5.7, Civil Engineer Water Supply Systems, 1979

2. Environment Engineering, 1982, Butterworth Publisher

3. Structural Handbook Civil Engineers, 1983

4. Utilities Supply Contract 2470-86C-7200, U.S. Naval Station, Miami, FL

5. Division Water Supply Engineering, Williamsburg, VA

6. American Water Works Association, Water Main Evaluation for Rehabilitation/ Replacement, 1986

7.* Maintenance Planning and Scheduling, Water Department, Cape Charles, VA 1994

8.* Chesapeake Water Treatment, TRIBUL-FLEX PM Schedule, Chesapeake, VA, 1994

9. McMaster-Carr Catalog, 1994

* Documents and personal tours

30.03 FLOCCULATOR SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 30.03.03-1
2	GS-II 30.03.04-2
3	GS-II 30.03.08-3

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 30.03.01-1
2	GS-III 30.03.01-2
3	GS-III 30.03.03-3
4	GS-III 30.03.03-4
5	GS-III 30.03.03-5

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-II 30.03.03-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: MECHANICAL STIRRER/MIXER
CONTROL NUMBER: GS-II 30.03.04-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor or gear box of the mechanical mixer/stirrer.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: MECHANICAL STIRRER/MIXER
CONTROL NUMBER: GS-II 30.03.04-2

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: TANK ACCESS STRUCTURES - METAL
CONTROL NUMBER: GS-II 30.03.08-3

Application

This guide applies to the investigation of cracks or cracked welds in metal ladders.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: FLOCCULATOR TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.03.01-1

Application

This guide applies to the investigation of cracks in concrete tanks.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: FLOCCULATOR TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.03.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter H. Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.03.03-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion; check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers (pistons) for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.03.03-3

Inspection Actions (Continued)

15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2 Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.03.03-4

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.03.03-4

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.03.03-5

Application

This guide applies to the investigation of electrical arcing noise from the pump motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.03.03-5

Inspection Actions (Continued)

13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

30.04 SETTLING TANKS

DESCRIPTION

Settling Tanks is a subsystem of the Water Treatment Plant System. Settling tanks facilitate the settling of flocculated material, the removal of the sediment and the removal of the floating scum. The settling tanks includes the pipes, pumps, tanks, collectors and launders.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following special tools and equipment, beyond the requirements listed in the Standard Tool Section, are needed for the inspection of Settling Tanks:

1. Dye, paintbrush, developer and rags

SPECIAL SAFETY REQUIREMENTS

The following list of special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of Settling Tanks.

1. Inspectors should utilize the installations notification procedures to secure safe access to the areas of chemical injections and storage especially in the areas of chlorination.

COMPONENT LIST

- 30.04.01 SETTLING TANKS - CONCRETE
- 30.04.02 SETTLING TANKS - METAL
- 30.04.03 PUMP ASSEMBLIES
- 30.04.04 SLUDGE COLLECTOR
- 30.04.05 LAUNDERS
- 30.04.06 PIPING, FITTINGS AND VALVES
- 30.04.07 GAUGES, RECORDING METERS AND SIGHT GLASSES
- 30.04.08 TANK ACCESS STRUCTURES - WOOD
- 30.04.09 TANK ACCESS STRUCTURES - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

23.01	POTABLE WATER DISTRIBUTION
30.01	SCREENING SYSTEMS
30.02	RAPID-MIX SYSTEMS
30.03	FLOCCULATOR SYSTEMS
30.05	RAPID SAND FILTERS
30.06	CLEAR WELL SYSTEMS

30.04 SETTLING TANKS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

a. Use Level I inspection method if HP is less than 5.
b. Use Level I & II inspection methods if HP is 5 to 40.
c. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized pump and motors applications.

Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common defects to be noted include, cracked tank foundations, cracked/spalled concrete, rusting tank walls and mechanical equipment.

COMPONENTS

◆ 30.04.01 SETTLING TANKS - CONCRETE

The settling tank provides a vessel where the flocculated solids are allowed to settle out. They are then removed by mechanical equipment. The tank is a reinforced concrete structure on a concrete base/foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ **30.04.01 SETTLING TANKS - CONCRETE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking.**			
Observation:			
a. Surface cracking, no signs of tank leakage.	LF		
*** {Severity L}			
b. Surface cracked, stains indicating fluid seepage.	LF		
*** {Severity M}			
c. Surface cracked, steady flowing leakage.	LF		1
*** {Severity H}			
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of member.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		2
*** {Severity H}			
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			
d. Exposure of reinforcing steel.	SF		2
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ **30.04.01 SETTLING TANKS - CONCRETE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	SF		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ 30.04.02 SETTLING TANKS - METAL

The settling tank provides a vessel where the flocculated solids are allowed to settle out. They are then removed by mechanical equipment. The tank is a steel structure usually mounted on a concrete base/foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			
*** Shell physical damage.**			
Observation:			
a. Dents and abrasions, no leakage or visible effect on tank operation.	SF		
*** {Severity L}			
b. Dents and abrasions, evidence of leakage (stains).	SF		
*** {Severity M}			
c. Dents and abrasions, steady fluid leakage.	SF		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners, evidence of leakage.	EA		
*** {Severity H}			
b. Cracked or broken welds, evidence of leakage.	EA		
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ **30.04.02 SETTLING TANKS - METAL (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated protective covering/corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ 30.04.03 PUMP ASSEMBLIES

Pumps facilitate the movement of water to the next treatment plant facility. The pump unit includes pump, motor, drive, wiring and controls.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump.**			
Observation:			
a. Cracked pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
*** Excessive pump noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	3
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	3
*** {Severity H}			
*** Broken/loose pump hardware.**			
Observation:			
a. Loose pump assembly or mounting bolts.	EA		
*** {Severity L}			
b. Broken or missing pump assembly or mounting bolts.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Leaking pump housing.	EA		
*** {Severity M}			
b. Leaking or damaged pump seals.	EA		
*** {Severity M}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ **30.04.03 PUMP ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Excessive motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	4
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	4
*** {Severity H}			
c. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ **30.04.03 PUMP ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Pump drive defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Loose, damaged or deformed coupling.	EA		
*** {Severity H}			
e. Missing coupling.	EA		
*** {Severity H}			
*** Float control hardware defects.**			
Observation:			
a. Loose, deformed or binding linkage.	EA		
*** {Severity M}			
b. Inoperative float control mechanism.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ 30.04.04 SLUDGE COLLECTOR

The settled by-product is called sludge. This is collected in a variety of ways, traveling bridges using suction, or scrapers (flights) and skimmers pushing product to collection launders, sumps, basins or troughs. Because these units are most effective at slow speed, the drive mechanism typically includes gear reducers and chain/sprocket assemblies.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	6
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	2	6
*** {Severity H}			
*** Damaged motor/gear reducer.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Broken/loose motor/gear reducer hardware.**			
Observation:			
a. Loose assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing inspection covers.	EA		
*** {Severity M}			
c. Broken or missing assembly bolts.	EA		
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ **30.04.04 SLUDGE COLLECTOR (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Chain/sprocket deterioration.**			
Observation:			
a. Loose or worn chains, sprockets and/or rollers, less than or equal to 10 percent metal loss or adjustable.	EA		
*** {Severity M}			
b. Loose or worn chains, sprockets and/or rollers, greater than 10 percent metal loss or not adjustable.	EA		
*** {Severity H}			
c. Misaligned sprockets and/or rollers.	EA		
*** {Severity H}			
d. Rattling or grinding noise indicating defective bearing mechanism.	EA		
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			
*** Loose/missing chain guards.**			
Observation:			
a. Loose or damaged guard.	EA		
*** {Severity M}			
b. Missing chain guard.	EA		
*** {Severity S}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ 30.04.05 LAUNDERS

Weirs are devices in the settling tank which prevent floating solids and debris from leaving the tank with the effluent.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage.**			
Observation:			
a. Bent or deformed launder, less than or equal to 10 percent not functional.	EA		
*** {Severity L}			
b. Bent or deformed launder, greater than 10 percent not functional.	EA		
*** {Severity H}			
*** Deteriorated protective covering/corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

*** Material: Steel

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ 30.04.06 PIPING, FITTINGS AND VALVES

Piping, fittings and valves are used to transfer and route the tank fluids to the next treatment facility.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Bent or cracked fitting, leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Bent or cracked pipe, leaking.	LF		
*** {Severity H}			
*** Loose/missing supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Leaking valve.**			
Observation:			
a. Leaking check valve.	EA		
*** {Severity L}			
b. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ **30.04.06 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged valve.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem, valve operable.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Bent stem and/or valve inoperable.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ 30.04.07 GAUGES, RECORDING METERS AND SIGHT GLASSES

Gauges, recording meters and sight glasses are utilized to monitor the plant operations, pressures, flow and levels throughout the component system as it affects the overall plant function. The devices vary significantly in size and mechanical operation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Gauge defects.**			
Observation:			
a. Moisture behind lens.	EA		
*** {Severity L}			
b. Dial face not readable.	EA		
*** {Severity H}			
c. Lens broken.	EA		
*** {Severity H}			
d. Gauges inoperative.	EA		
*** {Severity H}			
*** Recording meter defects.**			
Observation:			
a. Housing corroded.	EA		
*** {Severity L}			
b. Lens broken.	EA		
*** {Severity M}			
c. Damaged or missing pen holders.	EA		
*** {Severity H}			
d. Recording device inoperable.	EA		
*** {Severity H}			
*** Sight glass defects.**			
Observation:			
a. Rust on inside of sight glass.	EA		
*** {Severity L}			
b. Sight glass, graduations not readable.	EA		
*** {Severity M}			
c. Sight glass broken.	EA		
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ 30.04.08 TANK ACCESS STRUCTURES - WOOD

Wood tank access structures include wooden stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage defects.**			
Observation:			
a. Wood surface fibers separated, less than or equal to 25 percent of the thickness affected.	LF		
*** {Severity M}			
b. Wood surface fibers separated, greater than 25 percent of the thickness affected.	LF		
*** {Severity H}			
c. Structural member deformed, broken or missing.	LF		
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Rot, fungus or decay.**			
Observation:			
a. Moist stained area.	LF		
*** {Severity M}			
b. Discolored, soft or crushed area.	LF		
*** {Severity H}			
*** Parasite damage.**			
Observation:			
a. Holes less than 1/8" DIA, surface sag, frass observed.	LF		
*** {Severity M}			
b. Large holes greater than 1/8" DIA, surface channels, punctures, and crushing.	LF		
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ **30.04.08 TANK ACCESS STRUCTURES - WOOD (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connections/anchorage.**			
Observation:			
a. Loose connections/anchorage.	EA		
*** {Severity M}			
b. Broken, split, or damaged connections.	EA		
*** {Severity H}			

30.04 SETTLING TANKS

COMPONENTS (Continued)

◆ 30.04.09 TANK ACCESS STRUCTURES - METAL

Metal tank access structures include metal stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage, cracking and buckling.**			
Observation:			
a. Impact damage, dents, bends, not affecting safety or function.	LF		
*** {Severity M}			
b. Deformation, twisting or bending from overload.	LF		
*** {Severity H}			
c. Stress or fatigue cracks in members.	LF	3	
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners.	EA		
*** {Severity M}			
b. Cracked or broken welds.	EA	3	
*** {Severity H}			
c. Missing bolts or fasteners.	EA		
*** {Severity H}			
d. Impact damage, broken brackets.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

30.04 SETTLING TANKS

REFERENCES

1. NAVFAC DM-5.7, Civil Engineer Water Supply Systems, 1979

2. Environment Engineering, 1982, Butterworth Publisher

3. Structural Handbook Civil Engineers, 1983

4. Utilities Supply Contract 2470-86C-7200, U.S. Naval Station, Miami, FL

5. Division Water Supply Engineering, Williamsburg, VA

6. American Water Works Association, Water Main Evaluation for Rehabilitation/ Replacement, 1986

*7. Maintenance Planning and Scheduling, Water Department, Cape Charles, VA 1994

*8. Chesapeake Water Treatment, TRIBUL-FLEX PM Schedule, Chesapeake, VA, 1994

9. McMaster-Carr Catalog, 1994

* Documents and personal tours

30.04 SETTLING TANKS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 30.04.03-1
2	GS-II 30.04.04-2
3	GS-II 30.04.09-3

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 30.04.01-1
2	GS-III 30.04.01-2
3	GS-III 30.04.03-3
4	GS-III 30.04.03-4
5	GS-III 30.04.03-5
6	GS-III 30.04.04-6

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-II 30.04.03-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: SLUDGE COLLECTORS
CONTROL NUMBER: GS-II 30.04.04-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor in the sludge collector.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing by outside when someone is working inside a walk-in unit.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: SLUDGE COLLECTORS
CONTROL NUMBER: GS-II 30.04.04-2

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: TANK ACCESS STRUCTURES - METAL
CONTROL NUMBER: GS-II 30.04.09-3

Application

This guide applies to the investigation of cracks or cracked welds in metal ladders.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: SETTLING TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.04.01-1

Application

This guide applies to the investigation of cracks in concrete settling tank walls.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: SETTLING TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.04.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete settling tank walls.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter H. Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.04.03-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion; check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers (pistons) for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.04.03-3

Inspection Actions (Continued)

15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.04.03-4

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.04.03-4

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.04.03-5

Application

This guide applies to the investigation of electrical arcing noise from the pump motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: PUMP ASSEMBLIES
CONTROL NUMBER: GS-III 30.04.03-5

Inspection Actions (Continued)

13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: SLUDGE COLLECTORS
CONTROL NUMBER: GS-III 30.04.04-6

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor in the sludge collector.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: SLUDGE COLLECTORS
CONTROL NUMBER: GS-III 30.04.04-6

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

30.05 RAPID SAND FILTER SYSTEMS

DESCRIPTION

Rapid Sand Filter Systems is a subsystem of the Water Treatment Plant System. The water flows through a system of tanks and filters to filter out any remaining fine suspended solids, prior to distribution. This is done through a series of pipes, pumps, tanks and sand filters.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are required to perform the inspection of the Rapid Sand Filter Systems:

1. Paintbrush
2. Dye penetrant

SPECIAL SAFETY REQUIREMENTS

The following list of special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of Rapid Sand Filter Systems.

1. Inspectors should utilize the installations notification procedures to secure safe access to the areas of chemical injections and storage especially in the areas of chlorination.

COMPONENT LIST

- 30.05.01 RAPID SAND FILTER TANKS - CONCRETE
- 30.05.02 RAPID SAND FILTER TANKS - METAL
- 30.05.03 PIPING, FITTINGS AND VALVES
- 30.05.04 GAUGES, RECORDING METERS AND SIGHT GLASSES
- 30.05.05 TANK ACCESS STRUCTURES - WOOD
- 30.05.06 TANK ACCESS STRUCTURES - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

23.01	POTABLE WATER DISTRIBUTION
30.01	SCREENING SYSTEMS
30.02	RAPID-MIX SYSTEMS
30.03	FLOCCULATION SYSTEMS
30.04	SETTLING SYSTEMS
30.06	CLEAR WELL SYSTEMS

30.05 RAPID SAND FILTER SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level III inspection as part of the basic inspection process. Additional Level III inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common defects to be noted include, cracked tank foundations, cracked/spalled concrete, rusting tank walls and mechanical equipment.

COMPONENTS

◆ 30.05.01 RAPID SAND FILTER TANKS - CONCRETE

The rapid sand filter is a vessel containing a filter media of sand and possibly other materials through which the effluent from the settling tank passes. Equipment is included for backwashing of the filter. The tank is a reinforced concrete structure on a concrete base/foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			
*** Cracking.**			
Observation:			
a. Surface cracking, no signs of tank leakage.	LF		
*** {Severity L}			
b. Surface cracked, stains indicating fluid seepage.	LF		
*** {Severity M}			
c. Surface cracked, steady flowing leakage.	LF		1
*** {Severity H}			

30.05 RAPID SAND FILTER SYSTEMS

COMPONENTS (Continued)

◆ **30.05.01 RAPID SAND FILTER TANKS - CONCRETE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of member.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		2
*** {Severity H}			
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			
d. Exposure of reinforcing steel.	SF		2
*** {Severity H}			
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	SF		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	SF		
*** {Severity H}			

30.05 RAPID SAND FILTER SYSTEMS

COMPONENTS (Continued)

◆ **30.05.01 RAPID SAND FILTER TANKS - CONCRETE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.05 RAPID SAND FILTER SYSTEMS

COMPONENTS (Continued)

◆ 30.05.02 RAPID SAND FILTER TANKS - METAL

The rapid sand filter is a vessel containing a filter of sand and possibly other materials through which the effluent from the settling tank passes. Equipment is included for backwashing the filter. The tank is a steel structure usually mounted on a concrete foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			
*** Shell physical damage.**			
Observation:			
a. Dents and abrasions, no leakage or visible effect on tank operation.	SF		
*** {Severity L}			
b. Dents and abrasions, evidence of leakage (stains).	SF		
*** {Severity M}			
c. Dents and abrasions, steady fluid leakage.	SF		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners, evidence of leakage.	EA		
*** {Severity H}			
b. Cracked or broken welds, evidence of leakage.	EA		
*** {Severity H}			

30.05 RAPID SAND FILTER SYSTEMS

COMPONENTS (Continued)

◆ 30.01.02 RAPID SAND FILTER TANKS - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated protective covering/corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.05 RAPID SAND FILTER SYSTEMS

COMPONENTS (Continued)

◆ 30.05.03 PIPING, FITTINGS AND VALVES

Piping, fittings and valves are used to transfer and route the tank fluids to the next plant facility.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Bent or cracked fitting, leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Bent or cracked pipe, leaking.	LF		
*** {Severity H}			
*** Loose/missing supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Leaking valve.**			
Observation:			
a. Leaking check valve.	EA		
*** {Severity L}			
b. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			

30.05 RAPID SAND FILTER SYSTEMS

COMPONENTS (Continued)

◆ **30.05.03 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged valve.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem, valve operable.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Bent stem and/or valve inoperable.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

30.05 RAPID SAND FILTER SYSTEMS

COMPONENTS (Continued)

◆ 30.05.04 GAUGES, RECORDING METERS AND SIGHT GLASSES

Gauges, recording meters and sight glasses are utilized to monitor the plant operations, pressures, flow and levels throughout the component system as it affects the overall plant function. The devices vary significantly in size and mechanical operation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Gauge defects.**			
Observation:			
a. Moisture behind lens.	EA		
*** {Severity L}			
b. Dial face not readable.	EA		
*** {Severity H}			
c. Lens broken.	EA		
*** {Severity H}			
d. Gauges inoperative.	EA		
*** {Severity H}			
*** Recording meter defects.**			
Observation:			
a. Housing corroded.	EA		
*** {Severity L}			
b. Lens broken.	EA		
*** {Severity M}			
c. Damaged or missing pen holders.	EA		
*** {Severity H}			
d. Recording device inoperable.	EA		
*** {Severity H}			
*** Sight glass defects.**			
Observation:			
a. Rust on inside of sight glass.	EA		
*** {Severity L}			
b. Sight glass, graduations not readable.	EA		
*** {Severity M}			
c. Sight glass broken.	EA		
*** {Severity H}			

30.05 RAPID SAND FILTER SYSTEMS

COMPONENTS (Continued)

◆ 30.05.05 TANK ACCESS STRUCTURES - WOOD

Wood tank access structures include wooden stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage defects.**			
Observation:			
a. Wood surface fibers separated, less than or equal to 25 percent of the thickness affected.	LF		
*** {Severity M}			
b. Wood surface fibers separated, greater than 25 percent of the thickness affected.	LF		
*** {Severity H}			
c. Structural member deformed, broken or missing.	LF		
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Rot, fungus or decay.**			
Observation:			
a. Moist stained area.	LF		
*** {Severity M}			
b. Discolored, soft or crushed area.	LF		
*** {Severity H}			
*** Parasite damage.**			
Observation:			
a. Holes less than 1/8" DIA, surface sag, frass observed.	LF		
*** {Severity M}			
b. Large holes greater than 1/8" DIA, surface channels, punctures, and crushing.	LF		
*** {Severity H}			

30.05 RAPID SAND FILTER SYSTEMS

COMPONENTS (Continued)

◆ **30.05.05 TANK ACCESS STRUCTURES - WOOD (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connections/anchorage.**			
Observation:			
a. Loose connections/anchorage.	EA		
*** {Severity M}			
b. Broken, split, or damaged connections.	EA		
*** {Severity H}			

30.05 RAPID SAND FILTER SYSTEMS

COMPONENTS (Continued)

◆ 30.05.06 TANK ACCESS STRUCTURES - METAL

Metal tank access structures include metal stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage, cracking and buckling.**			
Observation:			
a. Impact damage, dents, bends, not affecting safety or function.	LF		
*** {Severity M}			
b. Deformation, twisting or bending from overload.	LF		
*** {Severity H}			
c. Stress or fatigue cracks in members.	LF	1	
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners.	EA		
*** {Severity M}			
b. Cracked or broken welds.	EA	1	
*** {Severity H}			
c. Missing bolts or fasteners.	EA		
*** {Severity H}			
d. Impact damage, broken brackets.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

30.05 RAPID SAND FILTER SYSTEMS

REFERENCES

1. NAVFAC DM-5.7, Civil Engineer Water Supply Systems, 1979

2. Environment Engineering, 1982, Butterworth Publisher

3. Structural Handbook Civil Engineers, 1983

4. Utilities Supply Contract 2470-86C-7200, U.S. Naval Station, Miami, FL

5. Division Water Supply Engineering, Williamsburg, VA

6. American Water Works Association, Water Main Evaluation for Rehabilitation/ Replacement, 1986

* 7. Maintenance Planning and Scheduling, Water Department, Cape Charles, VA 1994

* 8. Chesapeake Water Treatment, TRIBUL-FLEX PM Schedule, Chesapeake, VA, 1994

9. McMaster-Carr Catalog, 1994

* Documents and personal tours.

30.05 RAPID SAND FILTER SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 30.05.06-1

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 30.05.01-1
2	GS-III 30.05.01-2

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: TANK ACCESS STRUCTURES - METAL
CONTROL NUMBER: GS-II 30.05.06-1

Application

This guide applies to the investigation of cracks or cracked welds in metal ladders.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: RAPID SAND FILTER TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.05.01-1

Application

This guide applies to the investigation of cracks in concrete rapid sand filter tanks.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: RAPID SAND FILTER TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.05.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete rapid sand filter tanks.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter H. Emmons

30.06 CLEAR WELL SYSTEMS

DESCRIPTION

Clear Well Systems is a subsystem of the Water Treatment Plant System. The Clear Well System is a vessel where the water receives its final treatment prior to distribution. The water is treated to remove bacteria, unpleasant tastes and odors, improve clarity and chemically enhanced for purification.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Clear Well Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following list of special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of Clear Well Systems.

1. Inspectors should utilize the installations notification procedures to secure safe access to the areas of chemical injections and storage especially in the areas of chlorination.

COMPONENT LIST

- 30.06.01 CLEAR WELL TANKS - CONCRETE
- 30.06.02 CLEAR WELL TANKS - METAL
- 30.06.03 CHEMICAL FEEDER EQUIPMENT
- 30.06.04 PIPING, FITTINGS AND VALVES
- 30.06.05 GAUGES, RECORDING METERS AND SIGHT GLASSES
- 30.06.06 TANK ACCESS STRUCTURES - WOOD
- 30.06.07 TANK ACCESS STRUCTURES - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

23.01	POTABLE WATER DISTRIBUTION
30.01	SCREENING SYSTEMS
30.02	RAPID-MIX SYSTEMS
30.03	FLOCCULATOR SYSTEMS
30.04	SETTLING SYSTEMS
30.05	RAPID SAND FILTERS

30.06 CLEAR WELL SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level III inspection as part of the basic inspection process. Additional Level III inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common defects to be noted include, cracked tank foundations, cracked/spalled concrete, rusting tank walls and mechanical equipment.

COMPONENTS

◆ 30.06.01 CLEAR WELL TANKS - CONCRETE

The clear well tank is a vessel for the final storage of treated water prior to distribution to the users. Some chemical adjustments may be made at this point. The tank is a reinforced concrete structure on a concrete base/foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, exposed reinforcing and/or piping deformed.	SF		
*** {Severity H}			
*** Cracking.**			
Observation:			
a. Surface cracking, no signs of tank leakage.	LF		
*** {Severity L}			
b. Surface cracked, stains indicating fluid seepage.	LF		
*** {Severity M}			
c. Surface cracked, steady flowing leakage.	LF		1
*** {Severity H}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ 30.06.01 CLEAR WELL TANKS - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of member.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		2
*** {Severity H}			
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			
d. Exposure of reinforcing steel.	SF		2
*** {Severity H}			
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	SF		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	SF		
*** {Severity H}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ **30.06.01 CLEAR WELL TANKS - CONCRETE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ 30.06.02 CLEAR WELL TANKS - METAL

The clear well tank is a vessel for storage of treated water prior to distribution to the users. Some chemical adjustments may be made at this point. The tank is a steel structure usually mounted on a concrete foundation and is usually covered.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			
*** Shell physical damage.**			
Observation:			
a. Dents and abrasions, no leakage or visible effect on tank operation.	SF		
*** {Severity L}			
b. Dents and abrasions, evidence of leakage (stains).	SF		
*** {Severity M}			
c. Dents and abrasions, steady fluid leakage.	SF		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners, evidence of leakage.	EA		
*** {Severity H}			
b. Cracked or broken welds, evidence of leakage.	EA		
*** {Severity H}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ **30.06.02 CLEAR WELL TANKS - METAL (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated protective covering/corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ 30.06.03 CHEMICAL FEEDER EQUIPMENT

Chemical feeders are devices for the insertion of various solid and gaseous chemicals into the water for disinfection and enhancing the quality of the water. The equipment includes mixers, proportioning pumps, piping/tubing, mix controls, and storage equipment.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Mixing vat defects.**			
Observation:			
a. Missing/damaged cover.	EA		
*** {Severity M}			
b. Loose/missing mounting hardware.	EA		
*** {Severity M}			
c. Noisy stirring/agitator motor and/or drive.	EA		
*** {Severity H}			
*** Cylinder storage defects.**			
Observation:			
a. Loose/missing cylinder securing devices - chains/straps.	EA		
*** {Severity M}			
b. Missing cylinder labeling.	EA		
*** {Severity M}			
c. Chlorine odor - indicating leaking cylinder valve.	EA		
*** {Severity H}			
d. Damaged or improper fusible plug in cylinder valve.	EA		
*** {Severity H}			
*** Instrumentation/control defects.**			
Observation:			
a. Corroded flow control device - operable.	EA		
*** {Severity M}			
b. Damaged/missing/inoperable flow control device.	EA		
*** {Severity H}			
c. Chlorine odor - indicating instrumentation leakage.	EA		
*** {Severity H}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ **30.06.03 CHEMICAL FEEDER EQUIPMENT (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Piping, fittings and valve defects.**			
Observation:			
a. Corrosion evident by minor pitting.	LF		
*** {Severity M}			
b. Corrosion evident by blistering, severe pitting.	LF		
*** {Severity H}			
c. Chlorine odor - indicating leak at fitting or valve.	LF		
*** {Severity H}			
d. Frayed or damaged flexible piping from cylinder to manifold piping.	LF		
*** {Severity H}			
e. Debris or storage blocking access to cylinders or equipment.	LF		
*** {Severity S}			
f. Missing/illegible pipe labeling.	LF		
*** {Severity S}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ 30.06.04 PIPING, FITTINGS AND VALVES

Piping, fittings and valves are used to transfer and route the tank fluids to the various plant functions and distribution systems.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Bent or cracked fitting, leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Bent or cracked pipe, leaking.	LF		
*** {Severity H}			
*** Loose/missing supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Leaking valve.**			
Observation:			
a. Leaking check valve.	EA		
*** {Severity L}			
b. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ **30.06.04 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged valve.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem, valve operable.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Bent stem and/or valve inoperable.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ 30.06.05 GAUGES, RECORDING METERS AND SIGHT GLASSES

Gauges, recording meters and sight glasses are utilized to monitor the plant operations, pressures, flow and levels throughout the component system as it affects the overall plant function. The devices vary significantly in size and mechanical operation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Gauge defects.**			
Observation:			
a. Moisture behind lens.	EA		
*** {Severity L}			
b. Dial face not readable.	EA		
*** {Severity H}			
c. Lens broken.	EA		
*** {Severity H}			
d. Gauges inoperable.	EA		
*** {Severity H}			
*** Recording meter defects.**			
Observation:			
a. Housing corroded.	EA		
*** {Severity L}			
b. Lens broken.	EA		
*** {Severity M}			
c. Damaged or missing pen holders.	EA		
*** {Severity H}			
d. Recording device inoperable.	EA		
*** {Severity H}			
*** Sight glass defects.**			
Observation:			
a. Rust on inside of sight glass.	EA		
*** {Severity L}			
b. Sight glass, graduations not readable.	EA		
*** {Severity M}			
c. Sight glass broken.	EA		
*** {Severity H}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ 30.06.06 TANK ACCESS STRUCTURES - WOOD

Wood tank access structures include wooden stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage defects.**			
Observation:			
a. Wood surface fibers separated, less than or equal to 25 percent of the thickness affected.	LF		
*** {Severity M}			
b. Wood surface fibers separated, greater than 25 percent of the thickness affected.	LF		
*** {Severity H}			
c. Structural member deformed, broken or missing.	LF		
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Rot, fungus or decay.**			
Observation:			
a. Moist stained area.	LF		
*** {Severity M}			
b. Discolored, soft or crushed area.	LF		
*** {Severity H}			
*** Parasite damage.**			
Observation:			
a. Holes less than 1/8" DIA, surface sag, frass observed.	LF		
*** {Severity M}			
b. Large holes greater than 1/8" DIA, surface channels, punctures, and crushing.	LF		
*** {Severity H}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ **30.06.06 TANK ACCESS STRUCTURES - WOOD (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connections/anchorage.**			
Observation:			
a. Loose connections/anchorage.	EA		
*** {Severity M}			
b. Broken, split, or damaged connections.	EA		
*** {Severity H}			

30.06 CLEAR WELL SYSTEMS

COMPONENTS (Continued)

◆ 30.06.07 TANK ACCESS STRUCTURES - METAL

Metal tank access structures include metal stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage, cracking and buckling.**			
Observation:			
a. Impact damage, dents, bends, not affecting safety or function.	LF		
*** {Severity M}			
b. Deformation, twisting or bending from overload.	LF		
*** {Severity H}			
c. Stress or fatigue cracks in members.	LF	1	
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners.	EA		
*** {Severity M}			
b. Cracked or broken welds.	EA	1	
*** {Severity H}			
c. Missing bolts or fasteners.	EA		
*** {Severity H}			
d. Impact damage, broken brackets.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

30.06 CLEAR WELL SYSTEMS

REFERENCES

1. NAVFAC DM-5.7, Civil Engineer Water Supply Systems, 1979

2. Environment Engineering, 1982, Butterworth Publisher

3. Structural Handbook Civil Engineers, 1983

4. Utilities Supply Contract 2470-86C-7200, U.S. Naval Station, Miami, FL

5. Division Water Supply Engineering, Williamsburg, VA

6. American Water Works Association, Water Main Evaluation for Rehabilitation/Replacement, 1986

*7. Maintenance Planning and Scheduling, Water Department, Cape Charles, VA 1994

*8. Chesapeake Water Treatment, TRIBUL-FLEX PM Schedule, Chesapeake, VA, 1994

9. McMaster-Carr Catalog, 1994

* Documents and personal tours

30.06 CLEAR WELL SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 30.06.07-1

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 30.06.01-1
2	GS-III 30.06.01-2

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: TANK ACCESS STRUCTURES - METAL
CONTROL NUMBER: GS-II 30.06.07-1

Application

This guide applies to the investigation of cracks or cracked welds in metal ladders.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: CLEAR WELL TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.06.01-1

Application

This guide applies to the investigation of cracks in concrete clear well tanks.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: CLEAR WELL TANKS - CONCRETE
CONTROL NUMBER: GS-III 30.06.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete clear well tanks.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter H. Emmons

APPENDIX A

ABBREVIATIONS

AIC	American Institute of Chemists
CAIS	Condition Assessment Information System
CAS	Condition Assessment Survey
CERL	Construction Engineering Research Laboratory
DCD	Data Collection Device
DIA	Diameter
EA	Each
ETC.	And so on
FT	Foot
GPM	Gallons Per Minute
GS	Guide Sheet
HP	Horsepower
HR	Hour
IE	That is
IU	Inspection Unit
LF	Linear Foot
N/A	Not Applicable
NAVFAC-MO	Naval Facilities Maintenance and Operations
NDT	Non-Destructive Testing
OS&Y	Outside Stem and Yoke
PE	Professional Engineer
PM	Preventive Maintenance

APPENDIX A

RPIL	Real Property Inventory List
SF	Square Foot
TM	Technical Manual
UOM	Unit Of Measure
YRS	Years
WBS	Work Breakdown Structure
°	Degrees of Temperature
°C	Degrees Centigrade
°F	Degrees Fahrenheit
=	Equals
'	Feet
>	Greater Than
≥	Greater Than or Equal To
"	Inches
<	Less Than
≤	Less Than or Equal To
/	Per or Over
%	Percent
+	Plus or Positive or Add
±	Plus or Minus
−	Subtract or Minus or Negative
·	Times or By
x	Times or By

APPENDIX B

GLOSSARY

Abrasions	A scraping or rubbing off, as of skin. A wearing away by rubbing or scraping, as of rock by wind and water.
Alignment	An aligning or arrangement in a straight line; a ground plan , as of a field work , railroad etc.
Ammeter	An instrument for measuring the strength of an electric current (rate of flow) in terms of amperes.
Anchorage	A device used to attach the structural members to the building frame.
Arcing	The band of sparks or incandescent light formed when an electric discharge is conducted from one electrode or conducting surface to another, characterized by relatively high current and low potential difference between electrodes.
Base Metal	The metal to be welded, soldered, or plated.
Backwashing	That part of an ion exchange or filtration process where a reverse upward flow of water expands the bed, effecting physical changes such as loosening the bed to counteract compacting, stirring up and washing off light, insoluble contaminants to clean the bed, or separating a mixed bed into its components.
Bearings	The support for a shaft, axle, or trunnion used to mediate friction; usually in conjunction with a lubricant.
Brushes	A conductive metal or carbon block used to make sliding electrical contact with a moving part.
Catwalk	A narrow fixed walkway providing access to an otherwise inaccessible area or to a piece of equipment for service; used above an excavation, drydock, or high building.
Centrifugal	Moving or tending to move away from a center (conveying away from a center).
Chain	A flexible series of joined links, usually of metal, used to pull, confine, or to transmit power; bonds; shackles.
Chlorination	Introduction of chlorine into a compound. Water sterilization by chlorine gas.

APPENDIX B

Clarity	The quality or condition of being clear.
Clear Wells	A tank or vessels used to store the product of a water treatment plant.
Colloids	A solid, liquid, or gaseous substance made up of very small, insoluble, nondiffusible particles (as single large molecules or masses of smaller molecules) that remain in suspension in a surrounding solid, liquid, or gaseous medium of different matter.
Commutator	That part of a direct-current motor or generator which serves the dual function, in combination with brushes, of providing an electrical connection between the rotating armature winding and the stationary terminals, and of permitting reversal of the current in the armature windings.
Concrete Cracks	Hairline cracks are defined as shallow cracks that are the width of a human hair, normally occur in a random pattern and result in no loss of surface. Medium and larger cracks can be larger than a hairline size and normally follow a pattern and result in surface loss.
Conduit	A tube or pipe used to protect electric wiring. A tube or pipe used for conveying fluid.
Conical	Resembling or shaped like a cone (a solid with a circle for its base and a curved surface tapering evenly to an apex so that any point on this surface is in a straight line between the circumference of the base and its apex.
Connectors	In an electrical circuit, a device for joining two or more conductors, by a low-resistance path, without the use of a permanent splice.
Controls	Automatic or manual device used to stop, start, and/or regulate flow of gas, liquid, and/or electricity.
Corrosion	The deterioration of metal or of concrete by chemical or electrochemical reaction resulting from exposure to weathering, moisture, or chemicals, or other agents in the environment in which it is placed.
Coupling	A metal collar with internal threads used to connect two sections of threaded pipe. The mechanical fastening that connects shafts together for power transmission.

APPENDIX B

APPENDIX B

Cycle	A period of time within which a round of regularly recurring events or phenomena is completed.
Cylinder	A solid figure described by the edge of a rectangle rotated around the parallel edge as axis: the ends of the cylinder are parallel and equal circles. Anything having the shape of a cylinder, whether hollow or solid. Specifically, the chamber in which the piston moves in a reciprocating engine; the barrel of a pump; a container used to hold and transport compressed gas for various pressurized applications.
Debris	Rough, broken bits and pieces of stone, wood, glass, etc. as after destruction; rubble. Bits and pieces of rubbish; litter. A heap of rocks.
Decay	A deterioration or decomposing as of vegetable matter
Defects	An imperfection or weakness; fault; flaw; or blemish. In materials a fault that may reduce the durability, usefulness, or strength.
Deformation	Any change of form, shape, or dimensions produced in a body by a stress or force, without a breach of the continuity of its parts.
Diaphragm	A separating wall or membrane, especially one which transmits some substances and forces but not others. In general, any opening, sometimes adjustable in size, which is used to control the flow of a substance or radiation.
Dielectric	A nonconductor of electricity; an insulator or insulating material.
Disinfection	The destruction or sterilization of the harmful bacteria, viruses, etc. in or on something.
Drive Assembly	The means by which a machine is given power or motion (as in steam drive or diesel-electric drive), or by which power is transferred from one part of an engine to another (as in gear drive or belt drive).
Drive Shaft	A shaft which transmits power from a motor or engine to the rest of a machine.
Dye Penetrant	A liquid with low surface tension, containing a dye or florescent chemical; which when flowed over a metal surface, is used to determine the existence and extent of cracks and other

APPENDIX B

discontinuities.

APPENDIX B

Effluent	The liquid waste of sewage and industrial processing. Flowing outward or away from. Liquid which flows away from a containing space or a main waterway.
End Bells	A hollow metal cylinder closed at one end and flared at the other. A conical device that seals the top of a blast furnace.
Erosion	The deterioration brought about by the abrasive action of fluids or solids in motion.
Fatigue	The tendency of a metal or other material to crack and fail under repeated applications of stress.
Filter	A device to separate solids, such as dust from air. A device to separate solids from liquids; using a porous article or material for separating suspended particulate matter from liquids by passing the liquid through the pores of the filter and sieving out the solids. A layer or combination of layers of pervious materials designed and installed in such a manner as to provide soil drainage, yet prevent the movement of soil particles due to flowing water.
Float Control Mechanism	Floating device used to transmit a liquid-level reading to a control apparatus, such as an on-off switch controlling liquid flow into and out of a storage tank.
Flocculation	The forming of small masses in a fluid through coagulation, agglomeration, or biochemical reaction of fine suspended particles.
Foundations	Any part of a structure that serves to transmit the load to the earth or rock, usually below ground level; the entire masonry substructure.
Frayed	Having been made or become worn , ragged or raveled by rubbing. To make or become weakened or strained.
Fungus	Any of a large group, including molds, mildews, mushrooms, rusts, and smuts, which are parasites on living organisms or feed upon dead organic material, lack chlorophyll, true roots, stems, leaves, and reproduce by means of spores.
Fusible Plug	A protective device used on a heated pressure vessel (for example a steam boiler), and containing a material that melts at a predetermined safe temperature to prevent the buildup of excessive pressure.

APPENDIX B

Gaskets	A continuous strip of resilient material attached to a panel or frame to provide a tight seal between the frame and the panel. Any ring of resilient material used as a joint to prevent leakage.
Gauges	A standard measure or scale of measurement; dimensions, capacity, thickness. Any device for measuring something as the thickness of wire, the dimensions of a machined part, the amount of liquid in a container, steam pressure, etc.
Gear Box	The unit consisting of the transmission gears in a transmission system. A case enclosing gears to protect them from dirt.
Half-cell Potential Test	In electrochemical cells, the electrical potential developed by the overall cell reaction; can be considered, for calculation purposes, as the sum of the potential developed at the anode and the potential developed at the cathode, each being a half-cell. This difference in potential can be detected by placing a copper/copper sulfate half-cell on the surface of the concrete and measuring the potential differences between the reinforcing steel and a wet sponge on the concrete surface. The reference cell connects the concrete surface to a high-impedance voltmeter, which is also connected electrically to the reinforcing steel mat.
Hangers	A wire, strap, or rod attached to an overhead structure, used to support a pipe, conduit, the framework of a suspended ceiling, or the like. A "U" shaped, stirrup-like bracket used to support the end of a beam or joist at a masonry wall or girder.
Housing	In a pump, motor, or fan the casing or enclosure which contains the parts of the piece and acts to protect the enclosed machinery.
Illegible	Very difficult or impossible to read because it is badly written or printed, faded, obscured by age, etc.
Impellers	The rotating member of a fan, turbine, blower, axial or centrifugal pump, or mixing apparatus. Also known as a rotor.
Influent	An input stream of a fluid, as water into a reservoir, or liquid into a process vessel. The raw sewage entering a treatment plant.
Infrared Temperature Tester	An instrument that focuses and detects the infrared radiation (heat energy) emitted by an object in order to determine its temperature.

APPENDIX B

Injections	The introduction of fuel, fuel and air, fuel and oxidizer, water, or other substance into an engine induction system or combustion chamber.
Isolate	To set apart from others; place alone. To separate (an element or compound) in pure form from substances with which it is combined or mixed.
Level	A horizontal line or plane; especially such a plane taken as a basis for the measure of elevation.
Life Cycle	Under normal conditions, the expected life span based on proper installation and preventive maintenance.
Lock-out	To make a valve or circuit inoperative by shutting out and putting padlocks or other restrictive devices on the unit and identifying the lock-out with a card or sign.
Lubricate	To reduce friction by providing a smooth film as a covering over parts that move against each other. To make slippery or smooth, to apply a lubricant.
Manifold	A section of duct, a fitting, or a pipe with a number of branches which are close together; designed to distribute a gas, or liquid evenly.
Mobilization	To put into motion, to bring into readiness for immediate active service; to organize (people, resources, etc.) for active service or use.
Monitor	Any of various devices for checking or regulating the performance of machines. A raised section of roof, usually straddling the ridge; that has openings, louvers, or windows along the sides to admit light or air.
Motors	Anything that produces or imparts motion; an engine especially an internal-combustion engine. A machine for converting electrical energy to mechanical energy.
Nozzles	A tube-like device, usually streamlined, for accelerating and directing a fluid, whose pressure decreases as it leaves the device.
Organic Matter	Of or having to do with a bodily organ. Having the characteristics of or derived from living organisms.

APPENDIX B

Packing Glands	Packing is the stuffing or elastic material around a shaft or valve stem or around a joint to prevent leakage. A stuffing box surrounds a shaft to prevent leakage by the use of packing; commonly used on water pumps; the packing gland is a movable part that compresses the packing in the stuffing box.
Paddles	An instrument or group of instruments looking like a relatively short oar with a wide blade at one end or both ends. Used to circulate a liquid in a vessel.
Parasite	A plant or animal that lives on or in an organism of another species from which it derives sustenance or protection without benefitting the host and usually doing harm.
Pistons	A disk or short cylinder closely fitted in a hollow cylinder and moved back and forth by the pressure of a fluid so as to transmit reciprocating motion to the piston rod attached to it, or moved by the rod to exert pressure on the fluid.
Pitting	The development of small cavities in a surface, owing to phenomena such as corrosion, cavitation, or (as in concrete) localized disintegration. The development of surface defects on a metal surface, e.g. small depressions, usually caused by electrochemical corrosion.
Plumb	Exactly vertical.
Pop-outs	A conical fragment that has broken out of the surface of the concrete leaving small holes. Generally a shattered aggregate particle will be found at the bottom of the hole, with a part of the fragment still adhering to the small end of the pop-out cone. Pop-outs are caused by reactive aggregates and high alkali cement. They are also caused by aggregates such as shale, which expand with moisture.
Proportioning Pumps	Also known as a metering pump. A plunger type pump designed to accurately control small-scale fluid-flow rates; used to inject small quantities of materials into continuous-flow liquid streams.
Pump	A machine that draws a fluid into itself through an entrance port and forces the fluid out through an exhaust port. A motor driven device used to mechanically circulate fluid in a system; also called a circulator.

APPENDIX B

Purification	A process used to rid a substance of impurities or pollution; usually by chemical or physical means.
Rivets	A short pin, of a malleable metal such as iron, steel, or copper, with a head at one end; used to unite two metal plates by passing it through a hole in both plates and then hammering down the point to form a second head.
Rot	Decomposition in wood by fungi and other microorganisms; reduces the strength, density, and hardness.
Rotor	The rotating member of an electrical machine or device such as the rotating armature of a motor or generator or the rotating plates of a variable capacitor.
Run-out Play	This term generally applies to the horizontal of branch circuits or the measurement of play in a bearing or shaft.
Scaling	The gradual and continuing loss of surface mortar and aggregate over an area; due to the failure of the cement paste caused by chemical attack or freeze/thaw cycles. The product resulting from the corrosion of metals. A heavy oxide coating resulting from exposure to high temperatures in an oxidizing atmosphere.
Screening Tanks	Used to strain out large objects such as sticks, rags, and orange peels. The debris is removed from the screen and then disposed of or sent to the grinding station.
Seals	A tight closure as against the passing of air and water, something that closes or fastens tightly or securely.
Sedimentation	After screening and grit removal, the wastewater still contains settlable and floatable solids. These particles can be removed by greatly reducing the wastewater's speed of flow. This is what happens during the process of primary sedimentation often called clarification.
Shell	A thin hollow cylinder; the outer wall of a vessel or tank.
Sight Glass	A glass tube sealed within a fluid system, providing a means to examine (visually) the fluid within the system.

APPENDIX B

Spalling	A roughly circular or oval depression in the concrete. Spalls result from the separation and removal of a portion of the surface concrete, revealing a fracture roughly parallel to the surface. Spalls can be caused by corroding reinforcement steel and friction from thermal movement; reinforcing steel is often exposed.
Sprockets	Any of a number of teeth or points, as on the rim of a wheel, arranged to fit into the links of a chain. A wheel fitted with sprockets on its outside.
Stator	A fixed part forming the pivot or housing for a revolving part (rotor), as in a motor, dynamo.
Storage Hoppers	A box, tank, or other container, often funnel shaped, from which the contents can be emptied slowly and evenly.
Troughs	A channel or gutter used to carry off a liquid.
Ultrasonic Pulse Velocity Test	An ultrasonic detector is used either in scanning (non-cointact) or in contact mode. The pulse velocity test uses the contact mode. A metal probe (transducer) supplied with the detector is stimulated by ultrasound and transmits the waves, when touched against equipment surfaces, to another detector. The velocity of this ultrasonic pulse is measured; the faster the pulse the more dense the material tested. The test can also detect and evaluate cracks, voids, delamination and other defects.
Vat	A large tank, tub, or cask used for holding liquids to be used in a process.
Vegetation	Plant life in general.
Vessels	A container or structural envelope in which materials are treated, processed, or stored; for example, pressure vessels, reactor vessels, agitator vessels, and storage vessels (tanks).
Vibration	Rapid, periodic, to-and-fro motion or oscillation of an elastic body or the particles of a fluid when displaced from the rest position or position of equilibrium, as in transmitting sound.
Voltage	Electromagnetic force, or difference in electrical potential, expressed in volts.

APPENDIX B

Weld	To unite metals by heating them to suitable temperatures, with or without the application of pressure, and with or without the use of filler metal.
Windings	One or more turns of wire forming a continuous coil for a transformer, relay, rotating machine, or other electrical device.

APPENDIX C

LIFE CYCLES

30 WATER TREATMENT PLANTS

30.01 screening systems

Tanks - Concrete	30 YRS
Tanks - Metal	25 YRS
Mechanical Equipment	15 YRS
Pipes and Fittings	20 YRS
Pumps	20 YRS
Motors	18 YRS

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

30.02 RAPID MIX SYSTEMS

Tanks - Concrete	30 YRS
Tanks - Metal	25 YRS
Mechanical Equipment	15 YRS
Pipes and Fittings	20 YRS
Pumps	20 YRS
Motors	18 YRS

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

30.03 FLOCCULATOR SYSTEMS

Tanks - Concrete	30 YRS
Tanks - Metal	25 YRS
Mechanical Equipment	15 YRS
Pipes and Fittings	20 YRS
Pumps	20 YRS
Motors	18 YRS

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

APPENDIX C

30.04 SETTLING TANKS SYSTEMS

Tanks - Concrete	30 YRS
Tanks - Metal	25 YRS
Mechanical Equipment	15 YRS
Pipes and Fittings	20 YRS
Pumps	20 YRS
Motors	18 YRS

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

30.05 RAPID SAND FILTER SYSTEMS

Tanks - Concrete	30 YRS
Tanks - Metal	25 YRS
Mechanical Equipment	15 YRS
Pipes and Fittings	20 YRS
Pumps	20 YRS
Motors	18 YRS

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

30.06 CLEAR WELL SYSTEMS

Tanks - Concrete	30 YRS
Tanks - Metal	25 YRS
Mechanical Equipment	15 YRS
Pipes and Fittings	20 YRS
Pumps	20 YRS
Motors	18 YRS

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988